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The Volta Centenary.

THAT famous men should be revered, and their memory kept green, is a tradition which the electrical industry holds in high esteem. No country can boast of having given birth to more numerous or more distinguished pioneers in electrical science than our own; if we cannot claim a monopoly of electrical genius, we can produce a list of names of unrivalled brilliancy—but we claim also that no nation in the world is more ready to accord a full measure of generous appreciation to the labours and inventions of foreign scientific men, and to join in paying homage to their memory. Hence this year, when Italy commemorates the centenary of the death of Volta, the inventor of the first known source of the electric current which until quite recent times was called "voltaic electricity," our thoughts turn to Como where his remains are interred, and where the Volta Centenary Exhibition was opened in May last. Many of us will recall the visit paid by the Institution of Electrical Engineers to Italy in 1903, when a tribute was paid to the memory of Volta at his tomb and a memorial shield was presented by the I.E.E. Students; there followed a most interesting tour in Northern Italy, including visits to the splendid hydro-electric generating stations by which Italian engineers had proved themselves worthy sons of a land noted for expertness in hydraulic engineering. Since then the work of Marconi has added a new jewel to the crown, and these two subjects—electrical communications and hydro-electric power—form the principal features of the Exhibition.

During the month of September the International Electro-technical Commission will hold an important conference at Como; there will also be an International Congress of Physics, which will be attended by eminent men of science from every country, and other important meetings will take place. The members of the I.E.C., as stated in our last issue, after their official labours are concluded will engage in a tour of fascinating interest, and we have received particulars of an "official pilgrimage to Italy," organised under the auspices of the Italian Government by the State Tourist Department, which includes a visit to Como and some of the principal Italian cities in connection

with the Centenary celebrations, and which is mentioned elsewhere in this issue. To escape from the rigours of this year's British summer and to revel in the sunshine under the azure sky of Italy, is a temptation to which our readers may gladly surrender—and we are certain that they will meet with a cordial welcome at the hands of their Italian confrères.

Electricity on Danish Farms.

In this issue we have pleasure in publishing an article by Mr. V. Faaborg-Andersen, secretary of the Royal Danish Electricity Commission, on the position of electricity as applied to agriculture in Denmark. The author, who has investigated the subject fully in his official capacity, as a delegate of the Danish State took part in the discussions which took place at the sectional meeting of the World Power Conference at Basle last autumn, and is exceptionally qualified to express an unbiased opinion on the situation; his remarks and conclusions will therefore be studied with interest by British readers, who are well aware of the high position occupied by Denmark in respect of agricultural development. Particular attention should be directed to the co-operative system which enabled the Danish farmers to develop an extremely valuable export trade, and has likewise proved effective in securing for them the advantages of electricity supply. Co-operation amongst farmers in this country, unfortunately, has made little headway; it might prove to be their salvation from an economic point of view—certainly it would greatly facilitate the adoption of electrical operation both by encouraging the extension of electric transmission lines into rural areas and by enabling the capital and running costs of expensive apparatus to be met without imposing too heavy a burden on the individual. The topographical and climatic conditions in Denmark are comparable with those obtaining in this country, and the cost of electricity is of the same order; hence the lessons derived from Danish practice have a direct bearing upon our own problems, and our thanks are due to Mr. V. Faaborg-Andersen for his valuable contribution to our knowledge.

Welded Steel Replacing Castings.

The American General Electric Co. is making extensive and increasing use of welded steel constructions for large components which would otherwise have to be cast. From the instructive particulars of this new departure which we quote elsewhere in this issue, it appears that the age of castings (so far as this firm is concerned) for large generator frames has now gone by. To-day such vital components are fabricated welded steel constructions. It is computed that, due to the change in design, an average saving of 33 per cent. is effected in net weight, and that the all-in costs are also appreciably lowered. Further, the losses incidental to even the minimum of wasted castings are cut out. In this last connection it has to be remembered, too, that such wastage is often detected only after a considerable amount of work, such as machining and the like, has been done upon the castings. Thus wasters in the past often involved much more than foundry costs. In addition, pattern-making costs, as well as moulders' and furnacemen's and accessory services, are obviated, nor are these entirely off-set by the cost of the alternative method of production and fabrication. The saving in storage floor room, by the elimination of many large patterns and core-boxes, is already very considerable, and the effect of this will be felt more and more as such economies increase. As illustrating the effect of the change-over in design, reference is made in the original articles to the present and past weights of a 15,000-kW generator frame. Originally the cast variety weighed 24,000 lb.; the welded component weighs only 10,000 lb.

For large frames the general practice is to roll the outside cylindrical shell to shape from plate material; the frame ends are cut to suit by means of an automatic gas-torch machine. The ends and the barrel of the frame are tack-welded together; then the frame is brought to the automatic welder. An instance is quoted of a frame, forty feet in diameter and six feet wide, which involved two thousand feet of weld.

Interesting data are also given of the rate of cutting material preparatory to fabricating. Thus, ½-inch plate is cut at the rate of 50 inches per minute, and 2-inch plate at seven and a half inches to the minute. It is stated that no difficulty is experienced in cutting plate even up to 8½ inches thick. It is also considered to be economical, in the case of small motors, to replace cast frames by rolled material when diameters are as small as 11½ inches.

So important does the Company consider the new departure to be, that a three months' practical welding course is now part of the regulation training of all apprentice draughtsmen.

British engineers will doubtless be interested in what their American cousins are doing. They may find here some incentive to the increased use of a process which they have already discovered to be of marked and marketable value.

Safety in Mines.

From the annual report of the Safety in Mines Research Board, issued recently (H.M. Stationery Office, price 9d. net), it appears that the electric safety lamp is not to have everything its own way. Researches are in progress with a view to improving its efficiency, but the flame lamp is being studied by the Board as well, and it has been found possible to increase the candle-power to 2 or even 3 c.p., whilst preliminary tests with a robust form of incandescent mantle, capable of standing rough usage, have resulted in the attainment of no less than 10 c.p. The costs as compared with those of the electric lamp, however, are not stated. Evidently the makers of miners' electric lamps, which are becoming so popular in some coal mines, will do well to investigate the possibility of introducing further improvements into their design.

Researches have also been carried out on flame-proof mining electrical apparatus, of which an account appeared in our last issue, and on the pressures produced on blowing fuses or striking an arc in flame-proof enclosures; the pressures observed were much lower than was anticipated, unless the arc was maintained.

A "Telegraphic Journal" of 1864.

It is interesting to note that a weekly paper called "The Telegraphic Journal" was started on January 2nd, 1864, and ran for one year; we are indebted to the courtesy of Sir Charles Bright, F.R.S.E., for the two volumes which comprise its brief career; they had been the property of his father, Sir Charles T. Bright. In its first issue the editor declared that it was "to be a Telegraphic Journal *pur et simple*, to be kept intact from inroads of alien departments of electrical and other sciences"—a different policy from that pursued by ourselves from the very first. Nor was it strictly adhered to by our predecessor, for even in the third issue there was printed a paper on the use of the magneto-electric machine for light-house arc lamps.

In that year, 1864, the "new Atlantic cable" was under construction, and it was approaching completion when the "Journal" ceased publication; and Sir Charles T. Bright had already vigorously advocated the extension of the telegraphs from India to China and Australia. Many items of great interest are to be found in those old volumes; in appearance they are very similar to the early volumes of "The Telegraphic Journal and Electrical Review," which was established in 1872, but we claim no connection with the journal of 1864—not even under the style of "New Series."

The Electrification of Agriculture in Denmark.

The author reviews the history and present position of electricity on the farm in Denmark, and describes the methods by which its use has been extended and may be further developed.

By V. FAABORG-ANDERSEN, M.E.E., Secretary of the Royal Danish Electricity Commission.

DEVELOPMENTS in industry have gradually led to an ever-increasing use of electricity in order to reduce as much as possible the operating cost incurred for motive power, and at the same time to increase production. Similar considerations have wrought great changes in agriculture during the last ten or twenty years, and the extent to which the application of electricity has gained ground, particularly in

Fig. 1.—Map showing High-Voltage Network covering Denmark.

countries dependent on agriculture as one of their chief means of livelihood, is only natural. By this means the rural population is enabled not only to share in the benefits to civilisation of electric light and power, but also in the economic advantages to be derived from the proper use of electricity.

Fig. 2.—Portable Motor Driving Thresher.

It is well known that Denmark, as an agricultural country, occupies a very important position, and it is therefore only natural that she should have had early recourse to electricity and ascertained if the advantages to farmers of this form of power were really such as to warrant its adoption.

The start was made at the turn of the century, when Professor Paul la Cour, of the People's High School at Askov, in connection with his experiments with a windmill of improved construction, advocated the installation of a small electric power plant on each property; the windmill was to supply motive power to the various machines on the farm and to a generator charging a storage battery, which in turn furnished electricity for lighting. Only very few farmers, however, could afford such an installation, or had sufficient technical knowledge to maintain it in operation. At that juncture, developments in other fields helped to solve the problem. In order to improve and standardise the quality of their produce, the farmers had formed co-operative societies which turned out to be very effective for the production and sale of dairy and slaughter-house commodities. Similar co-operative societies were then formed for the purpose of providing each farming community with the needful supply of electricity.

Between the years 1908 and 1913 numerous co-operative or share companies were established for the supply of direct current at 2 × 220 volts, and many of these early plants have been able, up to the present, to supply the farmers with power in sufficient quantities and at reasonable prices. Meanwhile, about the year 1910, the first high-pressure systems had appeared, and urban power stations were extending their lines over the surrounding country. The co-operative interests soon became aware of the advantages of the wholesale production of electricity, and independent rural distributing companies were established all over the country. These companies either generated electricity at their own central stations or contracted for the supply of energy from already existing large urban stations. Fig. 1 shows how the high-pressure network covers all Denmark. In the districts where no network is shown, there are numerous small d.c. generating plants,, and it is only in the thinly-populated moorland areas where buildings are scattered that electricity supply is lacking. The voltages most generally used are: for high pressure, 10,000 volts; for low pressure, 380/220 volts.

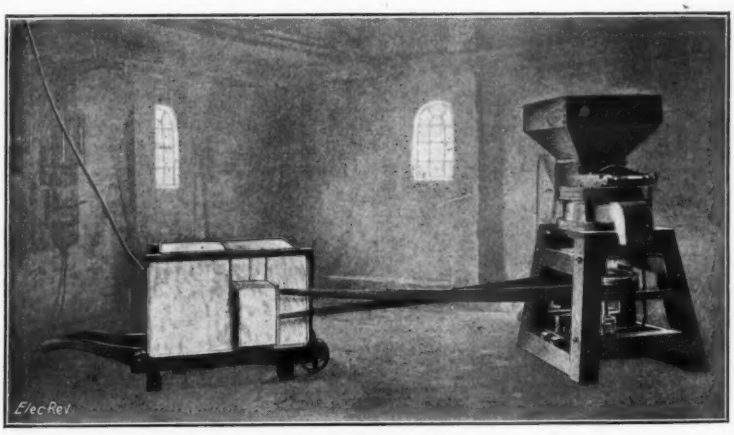


Fig. 3.—Portable Motor Driving Grain Crusher.

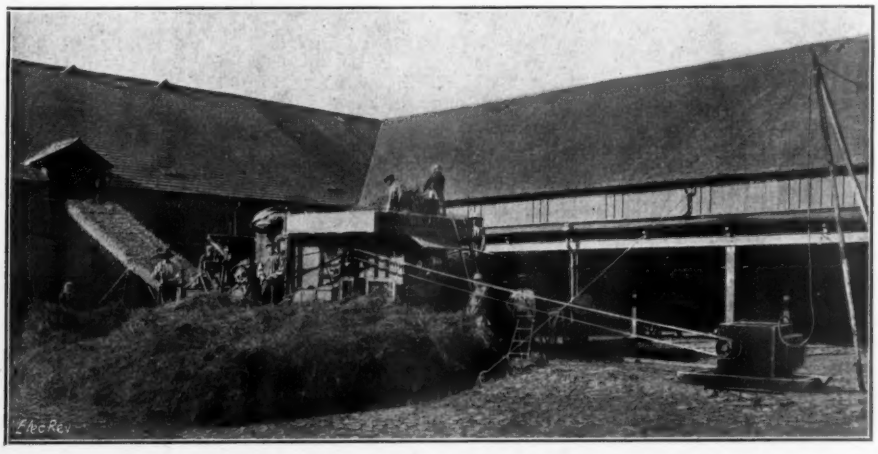


Fig. 4.—Electric Motor Driving Thresher and Straw Conveyor.

The fact that Denmark is a grain-producing country accounts for the very rapid development of the electricity supply systems. In every instance it was the co-operative societies' requirements of power for the above pur-

pose that made construction possible, and justifiable from an economic point of view. One has only to glance at the official statistics of the Danish electricity works to note that the use of power by the rural supply companies, whether at high or low pressure, in most cases is twice as much as the consumption for lighting. The difference between the power and lighting demands would prove still greater if an estimate could be obtained from the supply companies of the power consumed by those of their consumers who are actually farmers.

Fig. 5.—Sawing Firewood by Electric Power.

It would be too complicated to give here complete details regarding the different tariffs in use, which vary greatly owing to the vast dissimilarity of the districts in Denmark, both in respect of the size of properties and the quality of the soil. It may simply be stated that everywhere the price to the consumer is made up of a kWh rate for lighting and a kWh rate for power, to which are added certain fixed annual charges based on the number of lamp sockets, the h.p. installed, and the value of the property, or the number of acres under cultivation.

Electric power was first used for threshing, cutting chaff, and pumping water. It was not uncommon on small and medium-sized farms to install a 5- or 7½-h.p. motor to work the threshing machine, and a 2-h.p. motor for the chaff-cutter, while large farms, in addition to a 2-h.p. motor, installed a 20- or 30-h.p. motor for working the threshing machine, since, in Denmark, threshing is not done successively in the course of the year, but, in most cases, immediately after the autumn grain harvest.

Meanwhile it soon became apparent that, in order to ensure to the consumer the full benefits of electric power, the daily operating hours of the motors had to be extended; an excellent means to this end was the installation of milling machines for grinding corn fodder.

The following table gives an idea of the approximate consumption of power in 1926, on farms of various sorts and sizes, in a district with comparatively good soil. The figures are based on the controlled consumption per hectare (2½ acres) of a large number of farms situated in the territory of one of the largest rural supply companies:—

Description of property.	Consumption per ha.
Farm without milling machine (30 ha.)	11.0 kWh.
Farm with milling machine (42 ha.) ...	35.0 ,,
Landowner's farm with small herd of pigs	20.2 ,,
Estate farm	24.4 ,,

It may be seen from the above how large the increase in consumption is when a farm uses electricity for grinding its own corn fodder. The same supply company states that the average consumption of electricity in its territory may be estimated at 17 kWh per ha. per annum. As, according to the table, an ordinary farm using a milling machine consumes about 35 kWh per hectare, the present aim should be to raise the consumption to that figure, which would correspond to an increase in the present consumption of about 100 per cent. with the same number of users.

The possibility of raising the consumption per ha. still further, if new uses for electricity in addition to the above are found, is shown by the fact that single farms have consumed as much as 53 kWh per ha., or about 200 per cent. more than the present average. To what other kinds of farm work could electricity be applied to increase the consumption? They are various, and may be summarised as follows:

Sawing Firewood.

This can be done by one of the electric motors already installed, so that the only additional investment required is a circular saw. The estimated consumption for this purpose is 1 to 1.5 kWh per cubic metre of wood. For chopping brushwood (also used as firewood) there is a special 3 to 5 h.p. machine, which, attended by two men, is estimated to chop two loads per hour with a consumption of 1 to 1.5 kWh per load. This machine is particularly useful in districts where hedgerows abound, as it enables the clippings to be used which otherwise would be wholly or partly wasted.

Hay Baling.

This process can likewise be done by a 2 or 3-h.p. electric motor capable of baling two loads of hay per hour with an energy consumption of about 1 kWh per load. Considerable saving of storage space can thus be effected, as machine-baled hay takes up much less room than the hand-baled variety, and there would also be a saving in labourers' wages.

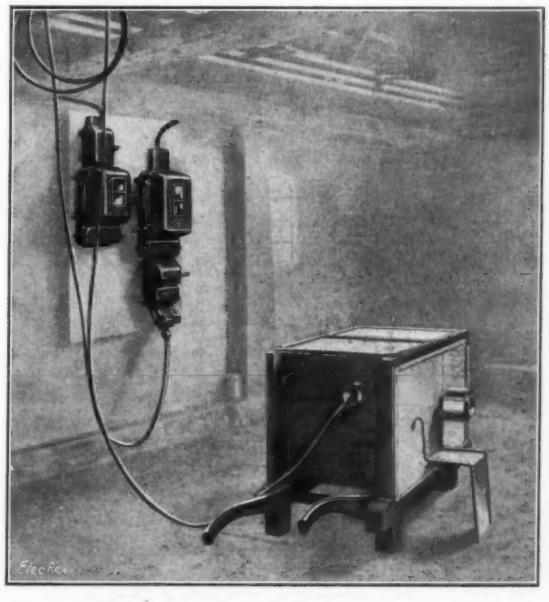


Fig. 6.—Portable "Thrige" Motor and Switchgear.

Conveyors.

Conveyors for harvested grain or threshed straw also require electric power. While, for grain conveyors, barns specially constructed to accommodate such machinery are required, limiting the possibilities to large farms, straw conveyors, in connection with a straw compressor, can be used on any farm to transport the straw from the thresher to the place where it is to be stored in the barn.

Oat Crushers.

Oats may be passed through special electric oat crushers before being fed to horses; oats thus treated have proved to be a superior fodder. The electricity consumed by one of the crushing machines amounts to about 0.5 kWh per 100 kilograms.

Winnowing Machinery.

Passing threshed seed, for example clover seed, through a winnowing machine, prior to sale, is also advantageous to the farmer. The small amount of electricity consumed in this process makes it worth while to do it with the electrical machinery already installed.

Milking Machinery.

Results obtained from electric milkers have been so far satisfactory that a good future may be predicted for them, but nevertheless there are certain factors to be considered. During and immediately after the war, when the cost of manual labour rose considerably, many farms had recourse to milking machines with which, at that time, they were well satisfied, although it was clear that the machines gave somewhat inferior quantitative results compared with hand milking, *i.e.*, it was not possible to milk the udder dry by machine. Later, the fall in cost of labour caused many of the larger farms to resume hand milking and to lay aside the machines. The question of cost of labour is likely to influence the future, consequently there is reason to anticipate, what indeed recent years have confirmed, that electric milkers will be installed and used chiefly on farms where the number of cattle does not warrant the employment of a special stall hand. In recent years farms with about 20 cows have begun to use a new type of machine. Milking with this takes about 1 to 1½ hours, and with a 1-h.p. motor consumes about 1 kWh. As milking takes place twice a day, the daily consumption is about 2 kWh. Further, experience has shown that a yearly amount of 20 to 30 kroner is required for the maintenance of the machinery, and this must be considered in estimating the profitableness of the plant.

Other Uses of Electricity.

On large farms refrigerators might be needed for cooling the milk before its distribution to the dairies for further treatment.

Attempts have been made in recent years to introduce electric feed boilers and hot-water boilers, but it is too soon to express an opinion as to the results of this propaganda, since these depend to a great extent on the prices at which the electricity works are able to supply energy during the night, and also on the cost of the apparatus and how simply their installation with the requisite meters, &c., can be carried out. Considering only feed values, the tests up to the present show that pigs in winter are more inclined to eat boiled or warmed-up feed and put on more weight per day than when cold feed is given them.

The application of electricity to ploughing and the preservation of ensilage, which is practised abroad, has not, so far as is known, been attempted in Denmark.

Wide experience in electrical installation has naturally been gained from the extensive use of electricity in farming in Denmark, and this again has led to the adoption of the very best grades, not only of wiring accessories, but also of electrical appliances and motors. The apparatus and motors used in Denmark are for the most part produced in the country; the motors here illustrated are of the "Thrige" manufacture.

Fig. 7.—Electric Cooking Apparatus in Farm-house.

Lastly, with reference to electricity for cooking and heating purposes, it may be remarked that in this respect the electricity companies have not, as yet, made much headway. This may be attributed to the comparatively high costs of electric stoves and kitchen ranges, and also to opposition arising from the conservatism of the Danish people. The subject, however, is certain to receive serious attention so soon as the supply companies, with a distribution system of increased capacity and better utilisation of the generating machinery, are in a position to supply electricity for cooking in requisite quantities and at a competitive price; but only the future will be able to answer the question as to the turnover to be expected from this field of use for electricity in the country.

Patent Law.

Some Incorrect Impressions concerning the Granting of Patents.

By JOHN JOHNSTON, M.A., LL.B.

A CONSIDERABLE number of people think that if a man gets a patent he has the indisputable right to the monopoly of manufacturing and selling the article patented. They do not distinguish between valid and invalid patents. Very many patents which are taken out annually are invalid. There are many which the Patent Office authorities know to be invalid at the time they grant them; but they have no alternative, being bound by certain rules of conduct which they cannot disregard.*

If an invention is published in any way no valid patent can be taken out for it subsequently. "Publication" in this connection does not mean merely publication in a book or newspaper or other periodical. If the inventor has told people about his invention, unless he has done so in either express or implied confidence, he can get no valid patent for it afterwards; probably giving the information to one individual would be sufficient. But he will get his patent though he has done this, and even though, before the date of his application, the identical invention has been published, either by him or by some one else, in a periodical—provided no one opposes the granting of his patent. The Patent Office officials do not search for anticipation outside their own records, and they cannot act with regard to such anticipation even though they know of it, or if it is

* Theoretically the Comptroller of Patents has the power to decline to grant any patent, but in practice he is bound by his rules. In one or two cases he may decline to grant a patent, *e.g.*, where the applicant admits that his invention has been exactly anticipated.

brought informally to their notice. If the granting of the patent is formally opposed, they can act, but it is not everybody who is allowed to oppose. It must be some one who is interested in the matter in a business way, *e.g.*, one who is manufacturing, or intending to manufacture, the article, and the grounds on which he can oppose are limited. They are far fewer than the grounds which would make a patent invalid. Consequently many people may know that a patent, if granted, would be invalid, though nobody opposes the granting of it.

If somebody applies for a patent for an article or device which, though not exactly the same as what has been done before, is yet so near to it that a man skilled in the subject and knowing what has been done before could make the thing in the ordinary course of his work, if he thought it advisable to do so, then a valid patent cannot be granted for it, since ingenuity is necessary for a patent to be valid; but the patent will be granted—whether it is opposed or not.

There are strong grounds for the view that something should be done to prevent these invalid patents deceiving the public. The Patents Act, 1907, Section 7, Subsection 4, states that the Comptroller of Patents shall, if a specification describes an invention which has been wholly or partially anticipated in a prior specification, or specifications, make a reference on the specification to such prior specification or specifications. These references might be extended to cover anticipations outside the Patent Records, *e.g.*, in technical magazines, or in foreign patent specifications, and they might be extended to cover the kind of anticipations which, though not exactly the same as what it is proposed to patent, would be enough to make the patent invalid. It is not proposed that the Patent Office officials should be asked to make searches outside their own records, but they might be allowed, and asked, to act on such information as they may have, or which may be brought to their notice, formally or informally, by any person whomsoever.

Another plan would be for the Patent Officials to make complete searches in technical literature and in foreign patent specifications, but this would involve such a new departure that it is not likely to be adopted without much consideration. It would make necessary certain alterations in the working of the Patent Office, as well as entail additional expense. The Patent Office, however, makes about £100,000 annually as clear profit, and this sum would do a good deal towards payment of such additional cost.

Multi-Range A.C. Instruments.

A *résumé* of the various types of instruments suitable for a.c. measurement at power frequencies, and their applicability to various purposes.

By E. H. W. BANNER, M.Sc., A.M.I.E.E., A.Inst.P.

THE types of instrument which can be used for a.c. measurements of current and voltage are:—Electro-static, of 1st grade accuracy (B.E.S.A.); thermal, 2nd grade; moving-iron, 1st grade; dynamometer, sub-standard grade; induction, 2nd grade; and, to some extent, one or two rectifiers with a moving-coil indicator. Part 1 deals with applications and ranges of the indicators of these types, independently of any accessory apparatus.

Most portable instruments can with advantage be multi-range, and the various means of producing a number of ranges form Part 2. High-frequency instruments, and some low-frequency standard laboratory instruments are briefly described and referred to, but are, in general, outside the range of the article.

A paper on multi-range d.c. instruments, by the author, has been published.[1]

PART 1.

The publication of the paper on "Some Recent Advances in Alternating-current Measuring Instruments" by Messrs. Edgcumbe & Ockenden, *Journal*, I.E.E., Vol. 65, p. 553; and ELECTRICAL REVIEW, Feb. 11th and 18th, 1927 (abstract) occurred after this article was written, and so, for completeness, parts have been added to the original article. For industrial use the moving-iron instrument appears to be generally accepted by instrument makers and designers as the survivor of the various types available.

Electrostatic Instruments.

The electrostatic voltmeter is essentially a potentially-operated instrument, but by measuring the potential difference across a shunt, inductance or transformer secondary, the current can be calculated. As voltmeters, the range of switchboard and portable instruments extends from about 100 V for full scale up to any value. Delicate laboratory instruments are available with a sensitivity as high as 9 V for full scale, but these are suspension instruments and suitable only for the laboratory.[2] For current measurements, if the potential applied has to be of the order of 100 V, a high-resistance shunt is required. This usually limits the range to small currents, and the chief application of this class of instrument as an ammeter is as a transfer instrument in standardising laboratories. Being free from wave-form, frequency and temperature errors, it is equally useful on d.c. or a.c., and so it is used calibrated on d.c. for checking other a.c. instruments. A precision form of voltmeter for standardising, described by Rayner[3], is in use at the National Physical Laboratory. Commercially, electrostatic voltmeters are used either when the current taken by the instrument must be negligible, or for very high voltages, when the comparatively simple construction becomes cheaper and less bulky than a current-operated instrument with series resistances or a transformer.

Thermal Instruments.

Two types of thermal instrument exist—the expansion and the thermo-e.m.f. types. The former is one of the earliest instruments, both as an ammeter and as a voltmeter. The latter is of fairly recent application to commercial purposes, although its use as a laboratory instrument is comparatively old. The range for the former type, as an ammeter, is from about a quarter to several amperes; higher ranges are obtained in various ways, as will be described later. For voltmeters the lowest full-scale range is about 1 V and the highest about 6, higher ranges usually being obtained by series resistances, but in any case the amperes and volts absorbed by the working wire alone are about as given above. The thermo-e.m.f. type has two sub-divisions, one with a junction in air, the other in vacuo. The air junction is simpler to make, and therefore cheaper. The vacuo-junction, besides being more sensitive, is far more amenable to accuracy of calibration. The range of ammeters of the former type is from a full-scale value of a few milliamperes up to several amperes, higher than the expansion type, whilst the power consumption is of the order of .2 watt per A. In the laboratory, by the employment of a separate sensitive

[1] The numbered references are to a bibliography which is appended to the article.

moving-coil galvanometer, the lowest range can be made to be only a very few milliamperes, and it then forms an efficient voltmeter, the power absorption being from about .002 to .03 W in the heater wire. Voltmeters of this type have in general limits of about a fraction of a volt to a few volts. The vacuo-junction type, being more sensitive, has a lower minimum, its upper limit is at present only a few amperes, and so some form of range extension becomes necessary for general use.

Thermal instruments have a relatively low overload capacity, the thermo-e.m.f. type being better in this respect than the expansion type. The power consumption is relatively high, particularly in high-range instruments, either ammeters or voltmeters, and with these two drawbacks this class of instrument is not in general use for power circuits. Its great application is to high-frequency work, where its independence of frequency and wave-form, and its low inductance and capacitance combine to make it almost exclusive in wireless and other high-frequency work. In a particular laboratory[4] a voltmeter for precision a.c. work consists of a reflecting moving-coil galvanometer with a high-resistance vacuo-junction. With this arrangement the heater current for full scale is about 2 milliamperes, and so the resistance is very high. It is suitable for any frequency except, perhaps, the most extreme radio frequencies. This arrangement is too delicate for commercial use, however. Moullin[5] has published a book and papers on radio-frequency measurements in general.

Moving-Iron Instruments.

The early moving-iron instruments were very crude, with heavy movements that were unable to follow rapid changes of current or voltage, high power consumption, and large frequency errors. The result is that this class of instrument still has a bad name with some engineers, although the modern moving-iron instrument is far better than any of the earlier models, and for a.c. a good model is practically as accurate as a corresponding moving-coil instrument for d.c. The application of this instrument to d.c. is often done for cheapness, and with modern instruments the hysteresis error is not excessive. It is certainly better, however, for a.c., and at all power frequencies, *i.e.*, up to 100 cycles per sec., it is unrivalled for switchboard work, both as an ammeter and a voltmeter. As a laboratory instrument a certain degree of precision can be attained. This class of instrument usually requires about 200-500 ampere-turns for its operation. As an ammeter, its practical lower limit is about 1 A, as smaller currents necessitate a high resistance. The upper limit is about 200-500 A, or that corresponding to a single turn of conductor acting on the movement. For higher ranges the excess current must be disposed of in some manner unless a larger number of ampere-turns is permissible and is counteracted by a stronger control. Voltmeters of a lower range than 10 V are of low resistance and are usually not corrected for temperature and frequency errors, so that this figure is the lowest usual full-scale value for this type. The upper limit is usually a few hundred volts, but any range can be accomplished, and the various methods are discussed in Part 2.

The consumption of ammeters is of the order of 2 volt-amperes for a 5-A instrument for full scale, and 4-10 volt-amperes per 110 V for a voltmeter. The consumption generally increases *pro rata* as the voltage, above 110 V. Portable precision instruments may have a power consumption as low as 1 watt, but not less. Later researches detailed in Messrs. Edgcumbe and Ockenden's paper show that improvements in design, together with the use of " mumetal " in place of other irons, allow of (1) a lower volt-ampere consumption, (2) a larger scale range, *i.e.*, 20 to 1 in their instruments, (3) a lower inductance, (4) a degree of precision hitherto unattained by moving-iron instruments, (5) negligible difference in reading between a.c. and (reversed) d.c. and (6) applicability of use at the lower telephonic frequencies (700 ~). In their ammeter the consumption is only .5 W. With the use of this design, therefore, the lowest full-scale ranges could probably be about 2 V and .25 A, without excessive power loss.

Dynamometer Instruments.

This class forms a series of standard instruments, which is the chief application of the type. Switchboard instruments are not general, except as wattmeters, as moving-iron instruments are far cheaper and quite as good for the purpose. The greatest advantage of these instruments in their inter-use for a.c. and d.c., provided that the a.c. is of fairly sinusoidal waveform. Given this condition, transfer instruments are possible, calibration being performed with d.c. and the instrument used subsequently with a.c. either for calibrating a.c. instruments, moving-iron and induction, or for direct measurements. Dynamometer instruments are accurate only up to a few hundred cycles per second, and so a waveform containing high harmonics will not be measured correctly, the electrostatic and thermal instruments alone reading true r.m.s. values under all conditions of wave-form. The usual limits of range are a few milliamperes to about 10 A, and one to several hundred volts. The power consumption is fairly high, having a minimum of about .5 W. This is at low ranges. High-range voltmeters are of the order of a hundred watts for several hundred volts. For very low ranges a voltmeter with full scale for 1 V has a resistance of about 2 ohms, so that on small-power measurements the use of these, or, in fact, most other a.c. instruments, is precluded. The wattmeter of this type is the usual standard for power supplies, either as a switchboard or a portable instrument. A very sensitive laboratory reflecting wattmeter of this type is described by Churcher.[4] Other specialised wattmeters have been described from time to time.[6,7].

Induction Instruments.

These instruments operate on a.c. only. The chief advantage over moving-iron instruments, for switchboard use, is the practicability of a scale arc of about 300 deg. With this exception moving-iron instruments, both ammeters and voltmeters, are preferable. The induction wattmeter has a scope nearly equal to the dynamometer, especially for switchboard use; as a standard instrument it is inferior. The lowest practicable ranges for this type are about 5 A and 50 V respectively. The energy loss in this type is of the order of 12 volt-amperes for ammeters and 15 volt-amperes for voltmeters. As this type is generally inferior to the moving-iron type, some instrument makers will not make or recommend it. Conversely, the induction watt-hour meter is a very widely-used and satisfactory meter.

Rectifier with Moving-Coil Indicator.

Although this is not a specific type of instrument, the combination has been thought worthy of inclusion for comparison with other relevant instruments. The rectification of an alternating current for measurement with a moving-coil indicator is an expedient sometimes used for special purposes, the essential principle being rectification by the suppression of one half of the wave by means of a thermionic valve and the measurement of this by means of a moving-coil milliammeter or galvanometer. Moullin[8] describes two thermionic voltmeters using triodes. This does not give a linear scale, however, chiefly on account of the curvature of the valve characteristics. The ranges of these particular instruments are 1.5 and 10 V for full scale. A later model has three self-contained ranges. Another instrument involving the use of a rectifier is the peak voltmeter, and its associated companion, the peak ammeter.[9,10,11]. Rectification of alternating currents by means of crystal rectifiers is employed as a rough laboratory method of measuring or detecting high-frequency currents. Perhaps the greatest use of rectifiers and d.c. instruments is in high-pressure circuits with currents of very small magnitude, *i.e.*, milliamperes, or even micro-amperes.

The author[12] has described these methods fully, and a brief recapitulation is made here.

With unsymmetrical waves, *i.e.*, partial rectification, a reading of R.M.S. current is of no value, apart from knowing the heating effect of the current, but the R.M.S. value of each half of the wave is what is required. If, then, two valves with milliammeters in series are connected in parallel and "back to back," each milliammeter will read the current corresponding to one half of the wave.

If the milliammeter is a moving-coil indicator, the mean current will be read, and if the current is large enough to be read on a moving-iron or other square-law indicator, the R.M.S. current of each half of the wave is measured. In X-ray and other high-pressure circuits where the wave is neither linear (d.c.) nor sinusoidal, this method is of great use. For further particulars, the original paper should be consulted, together with an addition published later.[13]

The ranges that can be dealt with depend entirely on the rectifier, moving-coil instruments being capable of any desired sensitivity. The lowest limit is, therefore, of the order of micro-amperes and the highest milli-amperes, an ampere being approached with the use of large valves or a number of paralleled smaller valves. Rectifiers, *i.e.*, diodes, only are necessary, but most triodes can be used by connecting together the anode and grid. For voltmeters, the limits are of the order of volts, directly on the instrument. These are not marketed as complete instruments, as far as the author is aware, but are generally assembled from laboratory materials to suit a particular test or circuit.

The Moullin voltmeter, described above, is marketed.[14]

(To be continued.)

L.P. Circuit-Breaker Operation.

A comparative review of the operation on short-circuit conditions of the various types of switches designed for l.p. work.

By J. O. KNOWLES, M.A.

THE design of circuit breakers for large currents and high voltages has been developed as a necessity. It is a triumph of design for such circuits to be interrupted satisfactorily at all. Low-pressure circuits can, however, be interrupted easily, and the design of suitable circuit breakers is now a matter of improvement and convenience.

Nevertheless, a switch used as an overload circuit breaker, whether on a switchboard or as part of a motor-starting equipment, is called upon sometimes to break really enormous currents, due to short-circuit surges. Supply cables are becoming heavier, the power requirements of the single factory are increasing and small sub-circuits carrying less than 100 A may be fed from cables or busbars capable of feeding thousands of amperes into the sub-circuit. The individual drive of medium and small motors brings the small starting panel into a position in the network, where a short-circuit will cause such a surge as to destroy the starter's circuit-breaking switch before the circuit is cleared by the opening of a circuit breaker farther back.

It was perhaps in the past sufficient to say of such an event "Lucky it was no worse," but post-mortems on such cases do help to improve future designs.

The ordinary knife switch is not opened on excessive currents; it has no overload release. The circuit switch in an ironclad case complies with the I.E.E. Rules if it breaks 50 per cent. excess current at 50 per cent. excess voltage. Some switches will still not do this, others will break up to 10 times the normal current at the normal pressure, and yet the switches in the two classes may look very much alike. The double break of equal length on each pole is a help, the quick long break is another, and perhaps most important of all is the arc-cooling or arc-splitting barrier near the path of the arc. The disposition of this barrier would be worth further investigation if it were not so easy to make a switch of this type break any current it is likely to carry. A margin of ten times normal current is ample when the switch does not open on overloads.

For interrupting short circuits there are many types of contact arrangement, all with different characteristics.

Consider first oil-immersed switches. There is the low-pressure oil switch made on the lines of similar h.p. apparatus, with wedge contacts dropping vertically deeper into the oil. When such a switch operates on a heavy surge of current, there is a groan and a wisp of smoke from the oil. The groan represents the stress set up in the oil by the making and quenching of the arc, and even though the fall of the switch is accelerated by a spring, this noise may be of quite appreciable duration, quite unlike the crack with which a blow-out contactor opens circuit. The time taken for such a switch to open is a minor point on l.p. work if the switch will open any reasonable short-circuit (if any "short" is reasonable!). The writer has seen (or rather heard) a switch of this type open circuit repeatedly on a current of 50 times the normal. In fact, a wedge-type oil-immersed switch will break more current than it will make! This sounds rather contradictory, but it is a striking way of saying that trouble on such switches is more commonly due to welding up on making circuit on a heavy surge than on failing to open, if the switch is already closed. When the tip of the wedge makes contact the burning of the "making" current may weld the tip of the moving wedge to the fixed contact, especially if the switch is *slow-make*. This weld can only be broken by a direct pull on the wedge and the operator has usually not much leverage on the handle which works the switch (see later remarks on contractors). In fact a direct pull on a welded wedge may distort and crumple up the fixed contacts. But the switch, if already closed, will open a circuit with a loading which it will not make, because the wedge contact leaves the fixed contact with considerable velocity as the arc begins to form.

The actual current at which welding takes place in making circuit varies enormously; so much depends on the mechanism for closing the switch. It is not desirable to close a heavy switch by spring action without a positive drive, but most oil switches almost encourage a slow and indecisive "make" action. Tests show, however, that with a cam-operated switch and a ratchet handle, it is possible to make about 40 times full-load current satisfactorily, even on pitted contacts, giving a safety factor of at least 6 assuming the switch

to be used for starting a squirrel-cage motor direct on the line. There is, however, very little margin of safety if the switch allows the operator to " inch " it in and out.

The drum type of oil-immersed switch is a common alternative to the drop-switch type, and its correct use lies in the smaller sizes. The drum is robust and compact, but its very robustness is a disadvantage in large sizes. The heavier the drum (and the oil " trapped " in the interstices of the drum) the more the inertia that has to be overcome before it opens circuit. Of course, the drum is already in motion before the contacts break circuit, because the drum contacts slide over the finger contacts for an appreciable distance. In larger sizes the inertia of the drum and the size of the contacts make it possible for the latter to get hot enough to weld up before parting, if the current is of a short-circuit value. Moreover, the spring that rotates the drum is not in the larger sizes usually made very strong, because the operator has not only to overcome this spring in closing the switch, but also to force the finger contacts to open and receive the drum contacts. Owing to the heavy normal pressure between the finger and drum contacts to secure cool running on the line contact, it requires some strength to close a heavy drum switch. The friction on roughened contacts also retards the opening of the switch, so as to make welding more likely. It is not very serious if a switch welds on making circuit, if another switch is used to open the circuit (as in the case of a drum-type switch with two drums, one acting as a circuit breaker and the other as a connection changing switch), but if a switch welds up in breaking, the surge current is not even reduced by the resistance of the arc and the whole work of opening circuit is thrown on to some switch farther back. Welding may take place on a drum-type switch at 10 to 20 times the normal current, according to its size and design.

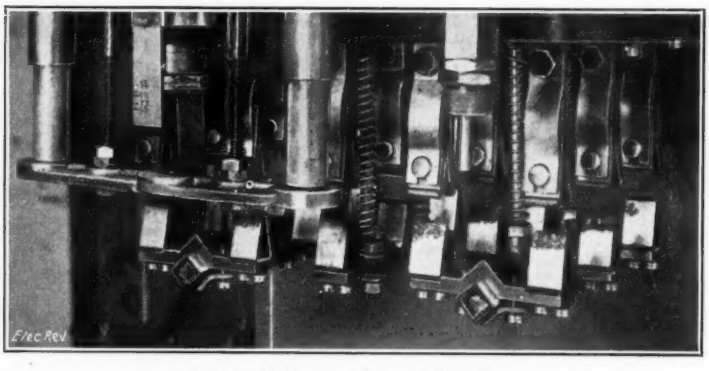


Fig. 1.—Oil-immersed Contacts, After Test.

Air circuit breakers may be of the drum-type when forming part of a starting unit; and here again the limit of breaking capacity may be determined in an otherwise good design by the welding current, rather than by the arc spilling over between phases or to earth. With a long fast break and good barriers between phases the drum-type air circuit breaker may interrupt repeatedly 10 times the normal current in the small sizes, for which this design is most suitable, though it is not wise to use up to its full capacity a switch having only a breaking capacity to 10 times its rated capacity to protect a motor which, when stalled, will take from 5 to 7 times full-load current, apart from any short-circuit that may develop in the cables or windings.

The butt-type copper contact, having a rolling action, has one great advantage over a wedge or drum contact. The rolling action gives an enormous leverage tending to break any weld which may begin to form on the contacts. Even when opening circuit on a current of 100 times the normal, the butt type of contact will tear open the weld that is beginning to form. The molten copper will, of course, feed the arc and this may strike a short-circuit path under such conditions, but the butt-type contacts will at least open with certainty, leaving only the problem of reducing the arc or of preventing further damage.

Without blow-outs the simplest type of butt-type switch in air may break 10 times its normal current on a single-break switch before the arc becomes unmanageable without shields of some kind. With a long break, wide spacing and good shielding, better results can be obtained, but a better solution is, of course, to provide magnetic blow-outs. A contactor with magnetic blow-outs will interrupt satisfactorily perhaps a greater current than any other form of switch of the same overall size. The limit of capacity is reached when the blow-out is so strong as to blow the arc on to the enclosing case, and there is probably more danger of this than of the arc maintaining as the blow-out must be strong enough to bend the arc on small currents and the same number of turns in the blow-out coil may give an excessively strong magnetic field on large currents.

Summarising these types, the various forms of circuit breaker, when tested to destruction on heavy short circuits, eventually fail from different causes in different types.

The oil switch with wedge contacts will break very large currents, but the arc is put out comparatively slowly and other contacts in the same switch may weld up while the arc is clearing. Further, welding-up may occur on the tip of the wedge in making circuit.

The drum type of switch is more likely to weld up in breaking at lower currents than the wedge type owing to the friction and delay on the line contacts.

The butt type of contact will break up any incipient weld, but the arc may run along (and in oil-immersed switches with butt contacts the butt contact in dropping tends to leave behind it, if not a vacuum, at least a swirl of oil at low pressure).

With a magnetic blow-out the air-break contactor with butt contacts is only limited by the spacing of parts, length of break, and clearance to case.

Finally, it should be added that the above remarks apply mainly to switches having a normal capacity not exceeding, say, 100 A at 550 V.

The accompanying illustrations show the results of comparative tests on an oil-immersed switch and an air-break contactor. Fig. 1 depicts the contacts of the former after making and breaking 40 times, increasing loads up to 50 times the normal capacity of the switch. Fig. 2 shows the air-break equipment after similar operations on increasing loadings up to 100 times the normal.

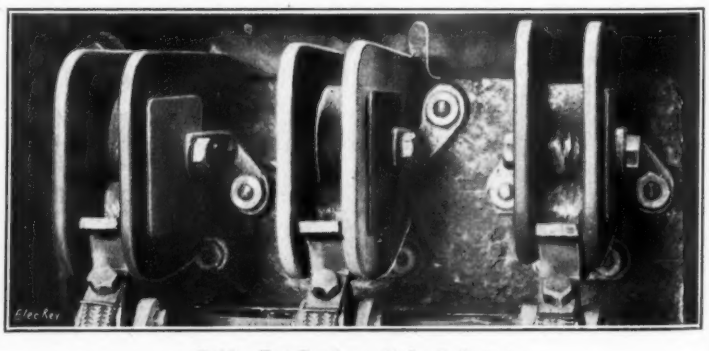


Fig. 2.—Test Result on Air-Break Contacts.

The photographs are reproduced by the courtesy of Messrs. Brookhirst Switchgear, Ltd.

The Art of Window Display.

With particular reference to the electrical dealer's business.

By ERIC N. SIMONS.

THE art of window display is a theme around which many controversies have centred and continue to centre, but certain prime conclusions emerge from the chaos of argument, and can be summarised in this article. On the whole, it seems to be accepted now that not only must each individual shop organise its window display in accordance with its character, but each particular class of goods must also receive treatment of a special kind. This involves thinking out not only the best way in which to feature radiators, say, as distinct from irons, but also the best forms of decoration, lighting, scheme of arrangement, price cards, and so forth. Furthermore, in addition to studying display from these individual points of view, the electrical retailer must pay some attention to the location of his shop, its situation in regard to the flow of people past it, its place in the street, its nearness to powerful arc lamps, and so forth.

Atmosphere is probably the most important factor of window display, especially in selling electrical goods. As a general rule, people walk by an electrical shop (or, indeed, almost any shop) so quickly that only a really striking and attractive window display will arrest their progress. The window display that does this must be more than arresting; it must be favourably arresting. Otherwise it will fail to create the right feeling of friendly interest leading to sales.

There is a good deal of controversy in regard to showing the prices of goods forming part of a window display. Some consider that the atmosphere is ruined by this introduction of the commercial. What is the good of showing a typical domestic interior, warmed by electric radiators and lighted by electricity, if the radiator and the lamps carry price tickets, as they would never do in a real home? is a typical query. Others, as against this, preserve an open mind, making the employment of price tickets dependent on the character of the display. Where a domestic interior, such as that described above, is concerned, a ticket may be out of place. In other instances, if small and neat, it may be an asset, and certainly is helpful to the prospective purchaser.

In general, it can be said that the use of price tickets in a window varies according to the type of person to whom appeal is made, the character of the display, and the type of goods exhibited. If price is a big factor in the neighbourhood, and is mentioned as a selling point in advertisements, price tickets should certainly be used. If the clientèle lies among a high-class circle, prices are better omitted. The remarks already made on the subject of atmosphere must be borne in mind as well.

Few expert window-dressers will now be found to combat the statement that one idea per window is the ideal at which to aim. The old-fashioned practice of jumbling a large number of widely-differing commodities together in one window, and leaving the beholder to pick out his own requirements from the jumble, is rapidly dying out. The aim of the retailer should be to decide, first of all, upon the subject of his window. If he intends to concentrate on domestic electrical heating, he should exclude everything likely to confuse the issue. First, he must find a central idea or selling-point on which to build his display. If the low price of his electrical heating appliances is the main point to be stressed, the display should be so arranged as to focus attention on price. If heat radiated is the selling point, the display should concentrate on this. Wireless sets and electric irons and everything unconnected with domestic heating should be rigorously kept out of the window.

No one can teach the retailer how to find happy central ideas. If he has imagination and a love for his work, he will find his experience in the shop productive of suggestions. If his mind is uncreative, he should employ an expert. One point is, however, worthy of special mention. *The aim of window display is to sell goods.* If it does not do that, it is a failure, no matter how pretty or artistic or clever it may seem. To attract attention is only half the battle. The public must be persuaded to buy.

There are two broad lines on which the dressing of windows runs. First, what may be called the straightforward endeavour to sell goods; secondly, the more subtle method, which attempts to make the shop window attractive, to create interest in and prestige for the shop, and to sell goods indirectly by this means. Both methods have their advantages, and can be employed with success.

One of the most trying problems that the electrical retailer has to face is the display of oddments, such as wire, "gadgets" of various sorts, torches, connections, insulated plugs, and so forth. These things have in them nothing intrinsically interesting. They do not of themselves attract a passer-by's eye. A good way out of this difficulty is to make up panels of these small items, artistically arranged, with emphasis laid upon the price, or whatever other selling point it is thought desirable to stress. Symmetrical arrangement can make a quite pleasing feature of what would otherwise be a formless litter.

The direct selling window, though naturally less likely to create a sensation than the window that concentrates on "atmosphere," should not be treated as if its arrangement and artistry were negligible. Much can be done by means of attractive settings (*e.g.*, shelf-papers, fixtures, coloured backgrounds, &c.) to enhance the appearance of quite ordinary objects.

But electrical goods lend themselves exceptionally well to the subtler forms of spectacular display. There are three main means of arousing interest in a shop window, and the electrical shop can employ all of them: colour, movement, light. There are, similarly, three types of spectacular display: seasonal, educational, artistic. These can be used by the same class of shop.

Seasonal displays are specially valuable because they stress a need already beginning to be felt. Thus, as the end of daylight-saving approaches, and the long nights draw near, the question of getting new lamps, new flash-lamps, electric radiators, and so forth, becomes immediate. Too many of the smaller electrical shops overlook the importance of seasonal display. Apart from special efforts round about Christmas, they do nothing, when in reality they ought to be seizing opportunities all the year round.

Educational displays are those in which the retailer tells the customer something he does not know about the goods. For example, one retailer showed a wireless valve in various stages of manufacture, each stage being accompanied by a simple, clearly-written account of how each stage was reached. Another showed a series of actual bills paid and receipted, proving conclusively that electricity was more economical than gas for certain purposes.

It has been proved beyond all possibility of doubt that windows should be changed frequently. Once a week is not too often. Some retailers in small towns or in suburbs of large towns imagine that it is not so necessary for them to change their windows often as for the larger central shops. Nothing could be further from the truth. In actual fact, it is more important

that the suburban or provincial retailer should change his window often than that the central shop should, for the simple reason that in a week or fortnight almost everyone in the small town or suburb will have seen the window, whereas the big central town audience constantly changes.

It is often asked whether window display can be tested for efficiency. The answer is that it can, but only by spending a good deal of time and trouble. A common method in the United States of America is for two employés to be stationed outside the shop, one to count the passers-by, the other to count the people who actually pause to look at the window. In this way a percentage figure of persons attracted is obtained, and comparisons of window displays with one another can be made. The results of some of these tests are interesting. One shop found that the inclusion of price tickets resulted in an increase of 2.4 per cent. of attention; in an increase of 1.8 seconds in the average time spent at the window; and of 86 per cent. in actual sales. Another found that display in many colours attracted 32 per cent. more attention than a mere one-colour display. Too much importance should not be attached to these results, since the weather, the season, the time of the week, and so forth, all have an effect that cannot be calculated mathematically.

Theft of Electricity.

The difficulty of proving fraudulent intent.

By W. ERIC JACKSON, LL.B., Barrister-at-Law.

THE possibility of fraudulently abstracting or stealing electricity bothered the Courts of Justice for some considerable time before Parliament specifically dealt with the offence by statute. The ancient rules of the common law, which laid it down that a conviction for theft could only be secured when there had been an actual "taking, stealing and carrying away," hardly applied to electricity. Consequently in 1882 the Electric Lighting Act (Section 22) provided that "every person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes or uses any electricity shall be guilty of felony, and on conviction thereof liable to be punished as in the case of simple larceny." This section has been re-enacted in the Larceny Act, 1916, and still remains in force.

Now, in setting out to prove the commission of such an offence, the first and most obvious fact is to prove that some electricity has in fact been wasted or used. This may be sometimes the most difficult to prove. A user may, for instance, have a shed fitted with electric lights or a motor which are connected with the main in such a way that the electricity does not pass through the meter. The discovery of the fittings may go some way towards proving an offence, but not the whole way. If it can be shown that the user himself put up the fittings, this will certainly constitute an attempt which will be punishable; but if the fittings were put up by some former tenant or other person, the mere existence of them will not prove anything. It becomes necessary to show that the occupier has used some electricity—no matter how small the quantity; and that he knew the fittings were improperly connected.

Here the electricity suppliers are often in some difficulty. It may be quite easy to set a watch in a suspicious case and obtain evidence that a supply has been used; but it may be an impossible task to prove fraud or malice in a case where the occupier says he took the premises in that state from a former occupier, and acted in ignorance.

For it must be noticed that the waste or consumption must be fraudulent or malicious. Hence, in a case where an unwitting householder drives a nail into a wall and causes a short circuit or waste of electricity which has not passed through the meter, no conviction could be obtained.

Where the meter supplied by the electricity undertaking fails to register properly, there will, of course, occur a waste or improper consumption of power. The position which then arises as to the householder's liability is rather unusual from the legal point of view. Most householders keep a monthly or quarterly check on their meters, and every householder should be able to estimate, from the use to which he puts his fittings, whether his meter is recording the full amount used In such cases it may well be said that a householder is morally guilty if he omits to point out any defect in the apparatus. But how many householders would? The matter may go on for months to the considerable loss of the suppliers; nevertheless, they would have great difficulty in establishing a criminal case against the user. They would have to prove an intention to defraud, and, of course, it is well nigh impossible to prove the state of another man's mind, especially when he merely rests inactive and pays only what he is asked. Moreover, the suppliers would have to show that electricity had been used beyond the quantity registered. The discovery of a faulty meter will not be enough unless at the same time it can be shown that the user has had his usual lights burning or his ordinary fittings in use. Mere diminution in the quantity registered will not provide enough proof.

Tampering with fittings will (without actual proof of abstracting or intending to abstract supply) not constitute a criminal offence, although a civil claim for damages may be made by the suppliers if the fittings tampered with were their property. The provision in the Act of 1882 dealing with injury to fittings only applies to "unlawfully and maliciously cutting or injuring any electric line or work with intent to cut off the supply," and does not deal with intention to defraud the suppliers.

In every case where a criminal offence can be proved, and in every instance where supply has been used, even unintentionally, damages can be claimed by the suppliers for the electricity consumed. In general, if the facts constitute a criminal offence, the prosecution in the criminal court should be instituted before the civil proceedings for damages are commenced in the county court. Here, again, the suppliers will find themselves in a difficulty, for they will not only have to prove that electricity has been used beyond the quantity registered on the meter, they will have to show what unregistered amount has been used.

At first sight it might seem easy to make an estimate of the quantity used by examining the capacity of the fittings, or by deducting the amount actually registered from the amount ordinarily consumed by other users with similar fittings. But this, of course, is not a safe method, and in reality proves nothing. For time is an element to be considered, and it will be impossible for the suppliers to prove for what length of time per day and over what period of days the improper fittings have been in use. It therefore seems useless to claim damages unless there is a flagrantly clear case. The whole position seems not entirely satisfactory from the suppliers' point of view; but it is not easy to suggest any amendment of the law to deal with the difficulty.

Earthing Systems.

Some Suggestions for the Construction of Earths at Generating and Sub-stations.

By T. J. B.

THE construction of generating station and sub-station earths merits more care than is sometimes paid to the work. On the efficiency or otherwise of the earthing system depends the satisfactory working of the protective devices which are actuated by earth current, the operation of lightning arrestors, and the safety of the operators. Too often a high efficiency of the method adopted is taken for granted, and no systematic tests to prove it are made.

At some generating stations and many sub-stations an extensive water-pipe system is available; such a system has a very low resistance to earth, since it covers a wide area and is certain to be partly in permanently moist earth. As to the advisability of the use of water pipes in this connection, however, opinions differ. One authoritative report states that water-piping systems afford by far the best earthing methods available, and should be used wherever possible. Another authority says that on no account must water pipes and the like be relied upon alone for the earth connections. It is certainly advisable to include the water-piping system in the station earthing system, otherwise, under fault conditions, there may be a dangerous potential difference between the earth lead and an adjacent pipe, unless the independent earth is exceptionally efficient. If the pipe system is connected to the station earth this danger is removed and the advantage of the low resistance of the pipe system is obtained, but care should be taken to make electrically continuous any parts of the system which may be insulated from each other by washers, packing or other insulating material, such as may be found in meters and the like.

Where possible, each important piece of apparatus should have its own earth; there should be one for the neutral points of the alternators, another for the neutral point of the l.p. system, a third for lightning arrestors, and another for earthing the bed-plates of the machines. All the earths should be connected together to secure the advantage of the lower resistance thus obtainable, but links should be inserted in the connections and in the main earth leads in order that each earth plate or other device may be disconnected from the others for testing purposes. If only one earth is used, it is advisable to use a separate earth lead for each important piece of apparatus to decrease the possibility of danger from any one earth connection becoming disconnected.

The earth conductor should be of ample size to carry the maximum earth current which may flow under fault conditions, and the efficiency and permanence of all joints and connections must be above suspicion. The earth connection should be as short and as straight as possible, especially the connection from the lightning arrestors.

Assuming an earth connection and an electrode of adequate size, the resistance of an earth is determined almost entirely by the resistance of the soil. The resistance of the soil will vary with its composition and with the moisture content. In really dry weather the resistance may be twenty or more times that when the soil is moist, but not necessarily wet. If permanently damp soil cannot be reached, and a supply of water is available, a pipe may be run into the ground near the earth and water poured down it in dry weather. In dry situations it is advisable to surround the earth plate with broken coke, packed down hard. The coke absorbs moisture in wet weather by capillary attraction, and keeps the surrounding soil moist in dry weather. The effect of moisture on the resistance of the coke itself is slight, and the coke may be regarded as an extension of the earth plate. The resistance of soil may be reduced by the addition of chemicals, such as common salt, but these require periodical renewal and may in some cases corrode the earth plate or conductor, and their use is only to be recommended under very difficult conditions, such as when the presence of rock prevents the earth plate from being buried at a sufficient depth to reach moist soil. The use of coke is usually more satisfactory, as it does not require renewal and is not so likely to cause corrosion.

Above freezing point the resistance of soil does not vary appreciably with the temperature, but at freezing point it increases enormously. In this country, of course, earth plates are hardly likely to be buried in soil which may be frozen even in the most severe winter, but the point should be remembered when installing earths in countries where the soil is likely to be frozen to a depth of several feet.

There is no particular advantage in the use of copper for earth plates instead of galvanised-iron, and the copper may have to be tinned to prevent corrosion. Rust does not appreciably increase the resistance of the earth, as a film of rust has not a greater resistance than an equivalent thickness of soil, but, of course, severe rusting may in time lead to the complete loss of the earth plate or to discontinuity at the earth-lead connection.

In this country flat earth plates are commonly used. They involve the maximum amount of excavation, though some saving in the labour cost of the installation can be made by installing the plate vertically, and not, as is often done, horizontally. One plate alone will seldom give an earth of sufficiently low resistance except for situations where only a small earth current can flow under fault conditions, and in any case it is necessary to have at least two earths in order that the resistance may be checked. For an important earth, two or more plates, each spaced twenty feet or more from the others, if possible, should be used. If permanently damp soil can be found at a depth of about six feet, there is little advantage in going lower.

Various special earthing appliances are available, one of the best known being the Paragon earth cone. This consists of a perforated cone-shaped copper sheet provided with a copper point and a similar cap; a copper cable, soldered to the point, is connected to the earth wire. The cone is installed by boring a hole with a post-hole auger, and surrounding the cone with finely broken coke, filling up with soil above the cone. This device is efficient, and results in a saving in installation costs, although the cone is, of course, more expensive than a simple earth plate.

Ordinary iron pipes can be used very successfully to form an earthing system. They need not be larger than 1 in. diameter, and they can be driven into the ground without any excavation, unless the ground is rocky, for about twenty feet, if necessary, to reach moist earth; moreover, they are cheap. A number of pipes connected together are required, and they should be spaced not less than four feet apart; there is not much to be gained by greatly exceeding this figure. Unless the soil is exceptionally dry, the pipes need not be driven down more than about eight feet. Except under favourable conditions and for unimportant earths, it will be found necessary to use at least four pipes connected in parallel, and where space is limited, this fact may necessitate the use of some other form of earthing device.

Plates consisting of a strip conductor are sometimes used. The strip should be about 2 in. wide, and laid in a straight trench which need not be more than a few

feet deep if the soil is fairly moist. The resistance of the earth thus obtained decreases with the length of the strip, but about forty feet is usually sufficient. If a straight trench cannot be obtained, the length should be increased. This form of earth is convenient for use at sub-stations where there may be only a few feet clearance surrounding the building: the strip can be run round the "sub," and will give an efficient earth in the minimum space. A pipe driven into the earth at each corner could be used under similar conditions, and although this method requires in addition a conductor to connect the pipes, the advantage of being able to disconnect these for testing purposes is obtained.

For what may be termed a power earth it is advisable to make a test to prove that the earth is capable of passing the maximum possible fault current without failure or undue rise of potential. Cases have been known of arcs forming between pieces of loosely packed coke, under fault conditions, and in an extreme case the resulting rise of temperature might cause a failure at soldered connections. If the earth is carefully constructed, and has a low resistance, a load test is not essential, but it should be carried out if possible. It is difficult to state what constitutes a low resistance. Water-pipe earths may have a resistance of a fraction of an ohm, and a simple pipe earth may have a resistance of twenty ohms or more. The B.O.T. regulation regarding earthing, in connection with tramways, gives a useful guide to what may be expected. This regulation states that an e.m.f. of four volts shall cause a current of not less than two amperes to flow between two plates not less than twenty yards apart.

Periodical tests for resistance should be made by disconnecting each earth plate in turn and testing it to the others. This will give a figure which may be compared with previous tests, and will show whether the earth is still sound and efficient.

One considerable advantage in the use of an earth consisting of a number of plates or pipes in parallel is that the potential gradient in the earth under fault conditions is reduced. According to a report issued by the National Electric Light Association of America, tests made by passing 30 A between a single- and a double-pipe earth 300 ft. apart showed a potential gradient of 6,900 V between the single pipe and a point in the ground one foot away. This figure represented 82 per cent. of the total volt-drop between the two earths. It will be seen that it is not safe to regard an earth lead as being at earth potential under fault conditions.

Small Domestic-Type Motors.

The requirements of the very small motor differ widely from those of the ordinary machine, and the author discusses them below.

By STUART F. PHILPOTT.

UNTIL within comparatively recent years the fractional horse-power motor was considered merely as a toy and beneath the serious consideration of many engineers.

However, mainly due to the rapid advance of domestic applications of electricity since the war, there has been an increasing demand for such motors, and many manufacturers have turned their attention in this direction. It was at first thought that the very small motor need only be a small edition of the ordinary commercial machine, but considerations, both economical and technical, soon showed this to be a fallacy.

The very small motor is essentially a mass-producduction job and, owing to the small quantity, but large variety, of materials used, labour costs bear a considerably higher ratio to the material or total costs than is the case with the larger machines. Efficient production methods are therefore particularly necessary. Although more and more small motors are being used for the individual drive of light machinery, it may be safely said that the majority of fractional horse-power motors go into domestic service.

Whilst different applications call for various special features, in the main, the tiny motors have to comply with certain requirements. They must be capable of running for long periods with little or no attention, bearing in mind that any attention they *do* get will generally be unskilled. Further, they must, within reasonable limits, be capable of running on any supply voltage, d.c. or a.c., and for the latter supply on any frequency. To what extent the second requirement is met in practice depends entirely on the product to which the motor is applied, and by whom it is sold.

For example, in the case of washing or wringing machines, for which at present there is not a huge demand in this country, it is conceivable that the necessity to wind the motor to suit a particular supply would not unduly dislocate the maker's production arrangements, whereas in the case of such articles as electrical vacuum cleaners and sewing machines, which are sold in thousands by non-electrical concerns, it is desirable and essential that the motors should be as universal as possible. In addition to the above requirements, there are other technical considerations to be met, such as sparking and heating, which are taken care of by the British Engineering Standards Specification for Fractional-Horse-Power Motors (No. 170/1926).

The following are the salient points concerning very small motors on the British market to-day:—

Armatures.—The majority of small motors have hand-wound armatures, though quite a number of manufacturers have adopted former winding. There is little available winding space on the small armatures, so that hand-winding is employed to get in as much copper as possible. The former-wound armature, of course, scores on the point of cheapness, and it is possible that in the future it will be more widely used for fractional h.p. machines than at present.

Fields.—Laminated fields are almost universally adopted to allow the motors to be operated on either direct or alternating current.

Brushes.—Carbon brushes are invariably employed in this country, though a few Continental and American makers supply the copper-gauze type; a fixed brush position is used universally.

Bearings.—In view of the conditions of service of most small motors, there is no doubt that ball bearings are superior to all others for this class of work. However, their cost is high compared with other types of bearings, and with the total cost of the motor, so that they have not been adopted to the extent that one would like. The plain bush bearing with wick lubrication appears to be the most favoured to-day, and certainly gives very satisfactory results.

Type of Enclosure.—Domestic conditions would seem to demand that for the most part motors should be totally enclosed. However, the majority of fractional h.p. motors on the market are of the enclosed-ventilated type.

Finish.—A few years ago the British very small motor was not all that might be desired in the matter of finish, but it is pleasing to note that this defect has been entirely overcome, and the average machine produced in this country to-day is quite equal to, or better than, the American product, which originally held the field for fine finish. A glossy black enamel finish is most popular in this country.

Details.—Examination of the products of various manufacturers shows that great attention has been given to such details as fixing methods, terminal arrangements, and so on, though in some cases there is still room for improvement in this respect.

There is no doubt that with the almost daily extension of electricity supply in this country, and the still greater extension to come, there is a wide field opening for the class of motor discussed here. Development, however, is retarded somewhat at present, as the price of many of the motor-driven domestic appliances is much too high for the purse of the average householder.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

Combines and Trusts in the Electrical Industry.

On August 25th the British Electrical and Allied Manufacturers' Association will publish an important monograph on "Combines and Trusts in the Electrical Industry," the result of almost two years' continuous economic research into developments in the leading countries of Europe. It constitutes the first real effort to clear up the international situation, and shows how rapidly the principle of combination, both in electrical manufacture and power finance, has been translated into practice abroad, with the result that the competitive position is gradually being dominated by a few powerful groups associated with American finance. The monograph is in essence a justification of combination, not merely in the electrical industry, but in all industries in this country which depend on exports for a high percentage of their output.

New Zealand Electrical Imports.

The *Board of Trade Journal* shows that during the last quarter of 1926 New Zealand imported electrical machinery to the value of £667,670. Of this Great Britain provided £356,960, the United States £185,448, Canada £47,618, and Australia £7,040.

Unemployment.

The total number of persons on the registers of employment exchanges in Great Britain on August 1st was 1,119,800. This was 92,898 more than a week before, but 498,944 less than a year before, when the figures were affected by the dispute in the coal industry.

Our Foreign Electrical Trade.

The following were the values of imports and exports of goods and machinery during July:—

	July, 1927.	Inc. or dec.	Seven months, 1927.
Imports.	£	£	£
Electrical goods and apparatus	311,562	+ 23,057	+ 201,922
Machinery	1,402,011	+332,601	+1,673,705
(Electrical machinery)	134,738	+ 30,116	+ 278,528
Exports.			
Electrical goods and apparatus	878,101	−214,021	+ 528,961
Machinery	3,786,141	−407,273	+ 989,526
(Electrical machinery)	543,412	+ 15,090	+ 662,176
Re-exports.			
Electrical goods and apparatus	12,202	− 4,433	− 22,789
Machinery	129,725	+ 4,473	+ 57,851
(Electrical machinery)	5,632	− 3,368	+ 9,571

Recent Contracts.

As we briefly reported in our "Contracts Closed" column last week, the ENGLISH ELECTRIC CO., LTD., has secured the contract for the complete electrification of the line from Christchurch to Lyttleton, New Zealand, which includes the Lyttleton tunnel through which the whole of the traffic between the North and South Islands must pass. The order comprises the overhead line equipment amounting to 45,000 yd. of overhead iine material and six "English Electric" 1,500-V locomotives of the 4-axle type, 3 ft. 6 in. gauge, each equipped with four D.K.86 motors and standard camshaft control. The electrical gear will be mounted in compartments and protected by doors interlocked with the control. The weight of the locomotives in full working order will be 50 tons. Also the necessary sub-station plant, which includes a single sub-station arranged to feed directly on to the middle of the overhead line without any feeders. Two rotaries supplied will be completely automatic. Remote control is arranged from both Addington and Christchurch stations, starting being effected by the operation of a single push button in either of these remote points. In addition to this remote starting arrangement, indication will be given at both remote points, whether the machines are running or not, and also alarm will be given at Addington station in the event of either machine being shut down for any reason. The transformers for the convertors will be of the company's standard outdoor type. They will be suitable for taking a supply at 10,500 volts, 3-phase, 50 cycles. This contract, which has a value of about £100,000, was secured in open competition with reputable manufacturers of the world, and undoubtedly the placing of the order with the English Electric Co. was largely influenced by the satisfactory results of the Otira Tunnel electrification, which was carried out by the company some time ago.

Messrs. BLACKSTONE & CO., LTD., have recently received from France an order for five 130-b.h.p., twin-cylinder, spring-injection, cold-starting heavy fuel oil engines.

Book Notices.

"Cox's Selenium Magnifier" (16 pp. illus.). London: H. W. Sullivan, Ltd.—This booklet describes in a very thorough manner H. C. Cox's selenium magnifier for loaded and unloaded submarine cables.

"Matriculation Magnetism and Electricity," by R. H. Jude and J. Satterly. Pp. xiii+427; figs. 237. London: W. B. Clive, University Tutorial Press, Ltd. Price 6s. 6d.

"German W.E.Z. Export Directory of German Manufacturers." Leipzig: W.E.Z./Economic and Commercial Gazette.

"Quarterly Bulletin of the British Cast Iron Research Association," No. 17, 1927.

"The Elements of Telephone Transmission," by H. H. Harrison. Pp. vii+147; figs. 72. London: Longmans, Green and Co., Ltd. Price 5s. net.

"Flame and Combustion in Gases," by W. A. Bone, D.Sc., and D. T. A. Townend, Ph. D. Pp. xvi+548; 162 figs. and 30 plates. London: Longmans, Green & Co., Ltd. Price 32s. net.

"Selected Papers from the *Journal* of the Institute of Electrical Engineers of Japan." No. 13, The Vibrometer. May, 1927.

"Data for Engineering Inquiries," by J. C. Connan, O.B.E., B.Sc. Pp. xv+324. London: Sir I. Pitman & Sons, Ltd. Price, 12s. 6d. net.

"The Direct Mail," June, 1927 (4 pp.). London: Smith, Dalby-Welch, Ltd.—This publication is designed to assist those who desire to utilise postal methods for advertising their goods. It contains an alphabetical list of the country's trades and professions, giving the number engaged in each. A map showing population by counties is enclosed as a supplement.

Czecho-Slovakian Tariff Reductions.

Under the recently-signed commercial treaty between Czecho-Slovakia and Hungary, the duties upon a number of classes of goods upon importation into Czecho-Slovakia have been reduced. Among the goods affected are telegraph and signalling apparatus, small switches and fuses, incandescent electric lamps, &c. The reductions apply to goods of United Kingdom origin.

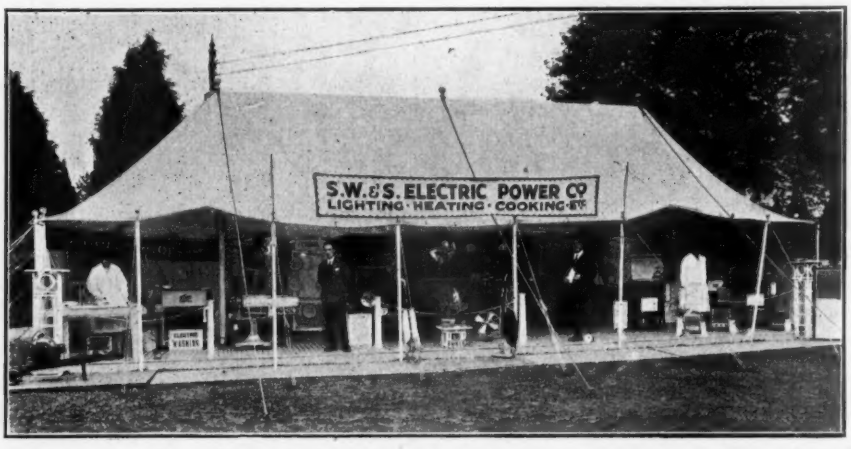
Russian Electrical Production.

The corrected estimates of electrical manufacturing output in the year 1927-28 show a production of the value of 157,078,000 pre-war roubles, or 33 per cent. above the current year's production. Of the total the State Electrical Trust will turn out 124.6 million roubles, the Low Pressure Trust 26.4 millions, and the Accumulator Trust 6 millions. The output of machines is to be increased next year by 40 per cent. to 43.5 million roubles and that of lamps by 22 per cent. The new "Transformator" works will begin activity in 1927-28, and the new factory for measuring apparatus at the end of that year. The number of workmen will be raised by 13 per cent., and the efficiency of labour will, it is said, be increased by 24.8 per cent. The reduction in the cost of production is to range from 3 to 6 per cent., while the capital expenditure in the year in question is not to exceed 15,000,000 roubles.

The Australian electrical industry is assisted considerably by the preference extended by Government authorities and others to Australian products. *The Times Trade and Engineering Supplement* recently showed that the Metropolitan-Vickers Electrical Co., Ltd., has secured a number of contracts by agreeing to manufacture a substantial proportion of the plant at its Auburn (N.S.W.) factory. These works were established in 1924-25 with a complement of 70 employés. A later contract necessitated the employment of a further 80, and a recent contract for railway equipment awarded by the N.S.W. Government will require 50 more to be taken on.

New Australian Companies.

Among the companies recently formed in Sydney (N.S.W.) are Stromberg-Carlson (Australasia), Ltd. (capital £50,000), manufacturers and importers of electrical and mechanical goods, &c.; and Scanlan Electric Signs, Ltd. (capital £25,000).

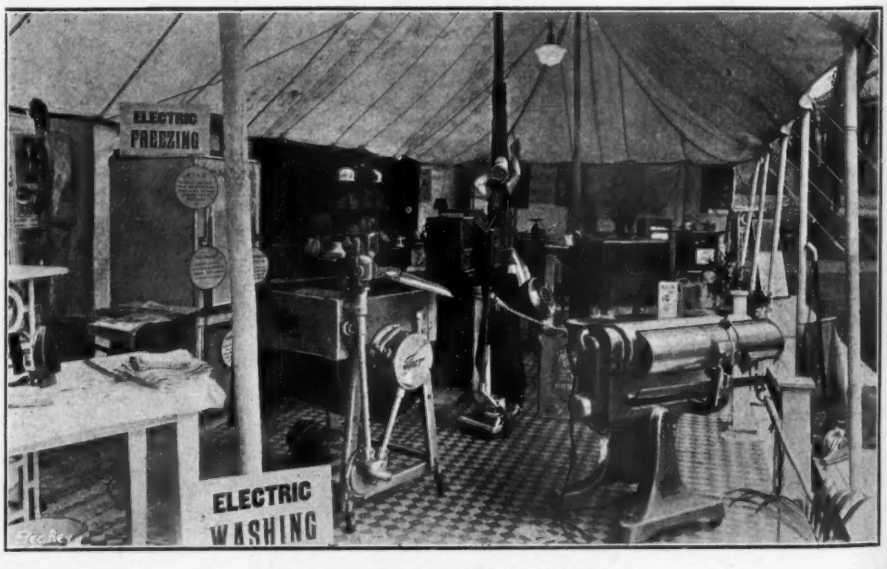


Great Britain's Radio Exports.

The *Wireless Trader* states that owing to an increase in exports in June the total value of shipments of radio apparatus for the first half of the year was only £7,784 lower than for the first half of 1926. The actual figures were:—1926, £664,304; 1927, £656,520 (including re-exports). Our principal foreign customer was Japan, which imported goods to the value of £103,181. Holland's share was valued at £35,055, while France was credited with £25,419, the United States with £25,041, Argentina with £14,402, Russia with £13,982, Portugal with £13,887, and Italy with £13,088. The largest share of all was taken by Australia (£124,950); other important Empire customers were India (including Burma), £43,924; New Zealand, £33,022; Canada, £16,351; and the Irish Free State, £13,937.

Electrical Demonstration at Droitwich.

The accompanying illustrations represent views of the electrical demonstration exhibition which was organised in connection with the Droitwich Spa Gala Week—August 1st to 6th inclusive—by the Shropshire, Worcestershire and Staffordshire Electric Power Company.



An Electrical Demonstration at Droitwich.

Sanitary Exhibition Awards.

The following were awarded silver medals for their exhibits at the recent congress and exhibition of the Royal Sanitary Institute at Hastings:—The British Hanovia Quartz Lamp Co., Ltd., quartz lamps for ultra-violet therapy; Electricars, Ltd., electric tipping dust wagon; Sturtevant Engineering Co., Ltd., turbine electric vacuum cleaner; and Hastings Corporation Electrical Department, hygienic value of electrical appliances. The following cases were deferred for further consideration or practical trial:—Electrolux, Ltd., electric cleaner and refrigerator; Hoover, Ltd., Tellus Super Vacuum Cleaner, Ltd., and Vampires, Ltd., electric cleaners.

Electrical Manufacturing in Australia.

The president of the Electrical Manufacturers' Association of New South Wales (Mr. A. E. Scanlan) stated recently that it would probably be found when the production statistics for the past financial year became available that the value of electrical apparatus produced in Australia would be in the neighbourhood of £2,000,000, and the wages paid in the industry in excess of £500,000. The latest available returns showed that there were 210 electrical factories in Australia producing apparatus valued at £1,482,967. Mr. Scanlan said that Australian electrical manufacturers were not afraid of the competition of Great Britain and the United States; what they most had to fear was the British and American manufacturers who had established allied factories in cheap wage countries to exploit the Australian market.

South African Locomotive Experiment.

The Railway Administration is inviting world-wide tenders for one electric freight locomotive. The authorities desire to find a locomotive which will be a big improvement on those in use at present, and it is their intention to test this single unit against the three units now being employed. The actual design is left to the tenderers, but certain specifications must be complied with. It is understood that if this experiment is successful this contract for one locomotive will be followed by one of the biggest contracts in the history of the South African Railways.—*Reuter* (Capetown).

Australian Preference for British Goods.

Replying recently to a deputation from the Australian Association of Manufacturers, Mr. Butler, the Premier of South Australia, said that all Government departments had been instructed to give preference to British goods over foreign products, and the Government intended to ensure that those instructions were carried out as fully as possible.

Trade Announcements.

Owing to the change-over to the automatic system, the telephone number of the EAST LONDON RUBBER CO. is now Bishopsgate 4321. There are twenty lines to its private branch exchange in London. The Sheffield branch number is also changed, being now 24233, with four lines.

Messrs. WARD, radio engineers, of Rugby, have removed their business from 14, Henry Street to 2, Railway Terrace.

Messrs. MUNN & UNDERWOOD, LTD., 165, Above Bar, Southampton, are giving up the wireless department of their business.

MESSRS. W. E. BEARDSALL & CO., LTD., 5, Victoria Bridge, Manchester, have been appointed agents in the North of England for the British B.A.G., Ltd.

The WHITWORTH ELECTRIC LAMP CO., LTD., has removed to 6 and 8, Gorleston Street (North End Road), West Kensington, London, W.14. Telephones: "0296 and 0297 Western."

Mr. A. W. SPEAR has joined the Nottingham staff of Messrs. Mayall & Co., Ltd., as representative.

We are informed that the name of the Siemens & English Electric Lamp Co., Ltd., has been changed to SIEMENS ELECTRIC LAMPS AND SUPPLIES, LTD. All contracts entered into and obligations incurred by the Siemens & English Electric Lamp Co., Ltd., will be carried out and discharged by Siemens Electric Lamps and Supplies, Ltd., which will also retain all the rights and privileges of the Siemens & English Electric Lamp Co., Ltd. Orders and inquiries should still be sent to 38-39, Upper Thames Street, E.C.4.

Mr. R. MILLIGAN, electrical and radio engineer, has opened premises at 39, East Gate, Inverness.

New Catalogues and Lists.

THE EDISON SWAN ELECTRIC CO., LTD., 123-5, Queen Victoria Street, London, E.C.4.—Twenty-page pocket booklet, giving illustrations and reduced prices of the Ediswan range of valves.

MESSRS. T. HARDING CHURTON & CO., LTD., Leeds.—Circular No. 700/A, giving brief particulars and tabular outputs and prices of their small squirrel-cage induction motors, Class A.

THE ELECTRICAL EQUIPMENT & CARBON CO., LTD., 109-111, New Oxford Street, London, W.C.1.—August stock list of small motors and dynamos, testing sets, cables, carbons, &c.

ASSOCIATED FIRE ALARMS, LTD., Jewin House, Redcross Street, E.C.1.—A folder dealing with the installation of the company's systems by a novel method.

METRO-VICK SUPPLIES, LTD., Trafford Park, Manchester.—Folder No. 4128/1, containing illustrations and prices of many types of electric lighting fittings, including bowls, lanterns, pendants, electroliers, and standards.

THE EVER-READY CO. (GREAT BRITAIN), LTD., Hercules Place, Holloway, N.7.—A comprehensive catalogue of the company's products, including dry batteries, accumulators, pocket lamps, torches, cycle lamps, &c.

THE CRESSALL MANUFACTURING CO., LTD., 31 & 32, Tower Street, Birmingham.—A priced and illustrated catalogue of asbestos woven resistance nets of many patterns.

THE STANTON IRONWORKS CO., LTD., near Nottingham.—August stock lists of spun-iron and cast-iron pipes.

MESSRS. JOHN SHAW & SONS, WOLVERHAMPTON, LTD., Wolverhampton.—Four illustrated and priced leaflets dealing, respectively with the "Trojan" electric iron, conduit fittings, handlamps and dry cells, and switch- and fuse-gear.

R.I. & VARLEY, LTD., Kingsway House, 103, Kingsway, W.C.2.—Two leaflets, illustrating and describing a resistance-capacity coupler and a h.f. choke. Priced.

THE HART ACCUMULATOR CO., LTD., Stratford, E.15.—A mailing card advertising the company's motor-car starting and lighting batteries.

The WESTERN ELECTRIC LAMP CO., 47, Victoria Street, S.W.1.—A price list of incandescent lamps, including automobile types and a circular letter containing a special offer.

The JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, S.W.1.—August calendar-blotter, advertising the "Jackson" lagged storage water heater.

GRAHAM AMPLION, LTD., 25-26, Savile Row, Regent Street, W.1.—A folder containing illustrations and prices of about a dozen horn and cone loud speakers and gramophone attachments.

Bankruptcy Proceedings.

BERNARD MONTAGUE MARKS, electrical engineer, late of 27, Canfield Gardens, Kilburn, N.W.—The first meeting of creditors herein was held last week at the London Bankruptcy Court. The Official Receiver reported that the receiving order was made on July 27th upon a creditor's petition. The debtor, who had traded as "B. Marks," started business at Dalston in 1911 with £100 capital. He closed it down on joining H.M. Army in 1914, and upon demobilisation in August, 1919, he became partner in a business carried on at 118, Wardour Street, W., under the style of the St. Mark's Electrical Company. The other partner retired in 1923 owing to bad trade, and the debtor then formed a small limited company, of which he became managing director at a salary of £7 or £8 a week. His wife advanced £250 to the company on the security of a debenture. The company traded until early in 1926, when it closed down, owing to bad trade and losses sustained through underestimating contracts. The debtor roughly estimates his liabilities at £500, and the only assets are book debts £516, of doubtful realisable value. The Official Receiver was left in charge of the estate.

NORMAN HURST WOOD, 32, Highbury Avenue, Thornton Heath, electrical engineer.—The first meeting of the creditors of the above was held on August 10th, at 29, Russell Square, W.C.1. The statement of affairs showed liabilities of £174, against assets of £10, leaving a deficiency of £164. Debtor attributed his failure to unemployment, law costs, and bad debts. The case, being a summary one, was left with the Official Receiver as trustee of the estate.

J. A. H. HALLIDAY, electrical engineer, 24, Duckworth Grove, carrying on business at 385, Worthington Street, Bradford.—A meeting of creditors was held on August 12th at the offices of the Official Receiver, Bradford. The statement of affairs showed a deficiency of £192. Debtor alleged lack of capital, bad trade and keen competition as causes of failure. The matter was left in the hands of the Official Receiver.

E. F. WOODGATE, 7, St. John's Terrace, Weymouth, electrical engineer.—The application for the discharge of this debtor was heard recently at the County Hall, Dorchester. A first and final dividend of 10s. 8d. in the £ had been paid on liabilities of £244. The proceedings were commenced in November, 1926. The debtor was granted his discharge, subject to a suspension for two years.

I. G. F. HARRIS, 74, Murray Road, and E. A. WHILEY, 30, Daffodil Road, lately trading as Goodman, Uttley & Harris, at 14, Broad Street Chambers, all Sheffield, radio accessory merchants.—The public examination was held on August 11th at the County Court Hall, Sheffield. The liabilities were put down at £141 and there were no assets. The examination was closed.

N. H. PAYNE, electrical and wireless engineer, 4, The Triangle, Teignmouth, and 11, Queen Street, Dawlish.—First and final dividend of 4s. 11d. in the £, payable at the Official Receiver's offices, Exeter Bank Chambers, 67, High Street, Exeter.

T. G. STEEL (Sprowston Motor Works), automobile and electrical engineer, Sprowston Villa, Sprowston Road, Forest Gate, E.—Bankrupt's discharge suspended for one year until July 12th, 1928.

J. G. SANDELL, electrical contractor, 20, Hart Street, Dorking.—Last day for proofs for dividend, August 24th. Trustee, Mr. T. Gourlay, Official Receiver, 29, Russell Square, W.C.

G. R. SIMS, motor and electrical engineer, Hartlepool Street, Thornley, Durham.—Last day for proofs for dividend, August 24th. Mr. W. A. Ellis, Official Receiver, 14, John Street, Sunderland.

W. HANNA, wireless dealer, 13, Carey Street, Burnley.—First meeting to-day (Friday), at the Official Receiver's offices, 11, Winckley Square, Preston. Public examination, September 13th, at the County Court House, Burnley.

R. HAWORTH, electrical engineer, 154, Duckworth Street, Darwen, Lancashire.—Trustee, Mr. H. Parker, Official Receiver, 11, Winckley Square, Preston, released August 2nd.

H. P. JACKSON, wireless dealer, &c., 70, Micklegate, York.—Trustee, Mr. D. S. Mackay, Official Receiver, Duncombe Place, York, released August 5th.

Company Liquidations.

RADIO ACCESSORIES, LTD., Hythe Road, Willesden, N.W.—A meeting of the creditors was held on August 15th at the offices of Messrs. Peat, Marwick, Mitchell & Co. The chair was occupied by Mr. E. Maloney, who had been appointed liquidator in the voluntary liquidation of the company, and receiver for the debenture holders. The chairman said that the company was formed in March, 1925, with a nominal capital of £60,000, and the whole of the capital was subscribed for and paid in cash by Burndept Wireless, Ltd. It was primarily registered to manufacture valves, and a good deal of money was spent in equipping premises at Willesden for the purpose; subsequently other premises were acquired for the manufacture of cabinets. The anticipated trade did not materialise, and between March, 1925, and June last there was a loss of £26,000. In addition, there was a sum of £11,000 in the balance-sheet for establishment expenditure and preliminary expenses, which was not represented by any available assets. The company spent £30,000 in equipping the premises. The draft accounts of the company for the year to February last disclosed a net loss of £20,000. A debenture had been issued to Burndept Wireless, Ltd., to secure advances, and when the results of the trading were seen, the debenture holders appointed him receiver. That was followed by the passing of a resolution for voluntary liquidation. He thought that the stock, work in progress, and book debts would not realise more than £5,000 net. He hoped to be able to come to some amicable arrangement with the receiver of Burndept Wireless, Ltd., but nothing definite had transpired. He also hoped shortly to negotiate for the sale of the company's interest in the premises. The amount due under the debentures was £10,900; there were trade creditors for £8,185, and claims had been intimated by persons who held service agreements totalling £13,700. The total liabilities were thus about £33,000. If the assets had to be sold under the hammer the outlook for the unsecured creditors would be extremely poor. If he could obtain an offer for the premises at Willesden there would be the possibility of a dividend for the creditors, but it was quite impossible to say what the

amount would be. There had been certain transactions between Burndept Wireless, Ltd., and Radio Accessories, Ltd., which were probably perfectly in order, but he was submitting a case to counsel. If counsel's opinion was favourable to Radio Accessories, Ltd., it would probably mean a reduction in the amount payable under the debenture. In reply to a question, the chairman said that practically throughout the boards of Burndept Wireless, Ltd., and Radio Accessories, Ltd., had been identical, with one exception. No resolutions were passed, and therefore the voluntary liquidation of the company will be continued with Mr. Maloney as liquidator.

Fellows Magneto Co., Ltd.—The statutory meeting of creditors was held on August 12th. The meeting was purely formal, a scheme having been entered into under which all the liabilities of the Fellows Magneto Co., Ltd., will be discharged in full by a new company called Fellows Manufacturing Co., Ltd.

Overseas Radio Co., Ltd.—Winding up voluntarily. Liquidator, Mr. W. J. Matthews, 5 and 6, Clement's Inn, W.C.—Meeting of creditors August 23rd, at the offices of the liquidator.

Ryders Ebonite Co., Ltd.—Winding up voluntarily. Liquidator, Mr. S. D. Payne, 8 and 9, Martin's Lane, Cannon Street, E.C. Meeting of creditors at the liquidator's offices on August 22nd. This notice is formal; all creditors have been or will be paid in full.

Radiophones, Ltd.—A meeting of members is called for September 2nd, at Chiswell House, Finsbury Pavement, E.C., to hear an account of the winding up from the liquidator, Mr. H. Lever.

Dissolutions of Partnership.

Morse & Bearman, wireless engineers and dealers in wireless apparatus and accessories, 45 and 46, Becontree Arcade, Chadwell Heath.—Mr. R. Morse and Mr. H. J. Bearman have dissolved partnership. Mr. Bearman will attend to debts and continue the business.

Nelson & Haley, plumbers and electrical engineers, 25, Grosvenor Road, Manningham, Bradford.—Messrs. H. Nelson, G. G. Dearman, and P. Haley have dissolved partnership. Messrs. Nelson & Haley will attend to debts and continue the business.

For Sale.

Birmingham Tame and Rea District Drainage Board has for disposal two 175-b.h.p. Belliss & Morcom compound steam engines direct coupled to 115-kW generators, one 4-panel h.p. switchboard, one 15-h.p. single cylinder steam engine, and two 225-b.h.p. a.c. squirrel-cage motors. By order of A. Griffiths & Co., successors to C. Purden, Ltd., Messrs. Shaw and Gilbert will sell by auction on September 6th at Lancaster Street and Lench Street, Birmingham, 200 electric motors and a quantity of electrical switchgear, starters, &c. Mansfield Corporation Electricity Department has for disposal surplus electrical generating plant, &c. The liquidator of Robinson & Hands Electrical Co., Ltd., invites offers for the manufacturing portion of the business carried on at Phillip Street, Aston, *viz.*, electric motor repairs, armature winding, and switchgear. The West Central Merchandise Mart has received instructions from a large shipping firm to sell by auction on September 14th, a quantity of v.i.r. and lead-covered cable, bowls, shades, lamps, cookers, electrical and wireless accessories, &c. (See our advertisement pages to-day.)

New Municipal Showrooms.

The Eastbourne Town Council has decided to have electrical showrooms constructed at Terminus Buildings.

Prices of Raw Materials.

Messrs. F. Smith & Co. report, August 16th:—Copper (electrolytic) bars, £63, 10s. inc.; ditto, ditto sheets, no change; ditto, ditto wire rods, £73, 10s. inc.; ditto, ditto H.C. wire, 9 3/16d., 1/16d. inc.

Messrs. James & Shakespeare report, August 16th:—No change in the prices of copper bars, sheet and rod; English pig lead, £24 5s., 5s. dec.

Messrs. Edward Till & Co. report, August 16th:—India-rubber Para fine, 1s. 3¾d., ¼d. inc.

Messrs. C. Clifford & Son, Ltd., report, August 16th:—Babbitt's metal and anti-friction metal, Grade I, £256, £2 inc.; Grade II, £177, £2 inc.; Grade III, £90, £1 inc.; phosphor bronze wire, 1s. 3½d., ¼d. inc.

In their letter dated August 13th, Messrs. James Forster and Co. stated that closing prices on August 12th were £23 3s. 9d. for August, and £23 13s. 9d. for November. There was a fall of 20s. per ton on August 8th, partly in sympathy with other metals, but chiefly due to the declarations issued that morning for a large quantity of early lead declared against August contracts. The advance of 30s. per ton in the latter half of July was due to speculation only, and had nothing to do with the actual intrinsic position of the metal. The American Bureau of Metal Statistics gives the world output of lead for June as 153,200 tons, and for the first six months of this year as 914,100 tons. The electrical trades this year are not so busy as in 1925-26, whatever the future may have in store. The world is producing far more lead than it can consume, and equilibrium will only be obtained when lower prices shut up mines which are expensive to work.

Lighting and Power Notes.

Ashford.—Loan.—The Urban District Council has applied for sanction to a loan of £6,200 for extending the cables to the villages of Kennington and Willesborough.

Australia. — Victoria. — The *Industrial Australian and Mining Standard* reports that apart from the Melbourne metropolitan railway system and the south-western district of Victoria, the demand for electric power from the State Electricity Commission has increased nearly 100 per cent. since 1922. In that year the demand was 44,265 kW; already this year it has reached 85,500 kW. This growth of demand is likely to be maintained in the future, both in the industrial and domestic spheres. It is necessary, therefore, to provide additional generating plant to keep pace with consumption. The output development is illustrated by the following figures:—1923, 6,000 kW; 1924, 16,600 kW; 1925, 29,000 kW; 1926, 43,000 kW; and 1927, 66,900 kW. The full capacity of the Commission's plants already in operation is about 70,000 kW, so that the State system is rapidly approaching full load conditions. Early next year it is expected that the first of the hydro-electric stations of the Sugarloaf-Rubicon system will be in operation, to assist in carrying the Commission's load of 1923, which, it is anticipated, will exceed 80,000 kW, of a total output of 94,000 kW.

Belgian Congo.—Hydro-Electric Development.—In its report for the past year the board of the Société Générale des Forces Hydro-Electriques du Katanga refers to the prospects for hydro-electric development in the Belgian Congo. It is estimated that in the Lower Congo area between Leopoldville and Matadi 100 million h.p. is available. For the present the company is centring its attention on a plant to utilise the Luffra falls on the river Congo with a capacity of about 50,000 h.p. The work in connection with this power station has so far mainly consisted of building a road and also a railway 37½ miles in length for the conveyance of material from the existing rail head to the site.

Bexley.—Electricity in Bulk.—The Foots Cray Electricity Supply Co., Ltd., has informed the Urban District Council that it has accepted an offer from the West Kent Electric Co., Ltd., for a supply of electricity in bulk as from April 1st, 1928. The Foots Cray Co. has been taking a bulk supply from the Bexley works.

Canada.—Hydro-Electric Development.—The *Financial Times* reports that a new 25,000-h.p. hydro-electric installation has recently been completed at St. Narcisse, on the Batiscan River, Canada, 20 miles from Three Rivers, Quebec. The site was originally developed in 1890 for a capacity of about 1,500 h.p. in three units, operating under a head of 80 ft., the power being transmitted to Three Rivers at 15,000 V by, it is claimed, the first h.p. line in the British Empire. The water is now carried to the new plant, some 4,200 ft. away, where a head of 160 ft. is obtained. The tunnel terminates in a reinforced concrete surge tank, from which two penstocks lead down to the 12,500 h.p. turbines. The generators are supported on concrete pedestals, and the operating floor is level with the turbine floor. The station will have an ultimate capacity of 50,000 h.p.

Canary Islands.—Electrical Development.—The Compania Insular Colonial de Electricidad y Riegos "Cicer," which was formed in Madrid in August last year for the purpose of establishing electric power stations in the Canary Islands and the Gulf of Guinea, has commenced work on the erection of a new 10,000-h.p. power station at Las Palmas.

Cheshire.—Overhead Lines.—Protests with respect to the placing of service overhead transmission lines through the villages of Weston, Haslington, Shavington and Willaston have been considered by the County Council Main Roads and Bridges Committee. It was stated that the agreement with the Electricity Distribution of North Wales and District, Ltd., did not stipulate for the placing of such lines underground when passing through villages, but that the clerk had written the company on the subject with a view to having the lines placed underground. It was resolved that in the event of the company's failing to place the lines underground, the clerk of the Council should give notice to the company to terminate the agreement.

Continental.—Russia.—The Gosplan of the Ukraine S.S.R. has approved in principle the five-year plan for the electrification of the Ukraine. In the Don basin it has been decided to increase the capacity of the Shterovski power station by 44,000 kW, install a new Tosovski station with two sets of 48,000 kW each, erect three sub-stations in the Makeyevski, Central and Luganski regions, enlarge the Kadievski sub-station, and lay a series of new transmission lines with a total length of 157 km. In all, £16,900,000 is to be spent during the next five years on electrical projects in the Don basin. In the other parts of the Ukraine electrical construction costing over £28,100,000 will form part of the five-year plan, £14,500,000 being spent on the big Dnieprstroï station. Dur-

ing the next five years, therefore, no less than £45,050,000 will be spent on electrification work in the Ukraine.—*Reuter's Trade Service* (Moscow).

SPAIN.—The Spanish and Portuguese delegates have reached an agreement regarding the utilisation of the waters of the River Douro for hydro-electric purposes. The project is now to be submitted to the respective Governments.—*Reuter's Trade Service* (Madrid).

Dewsbury.—ASSISTED WIRING SCHEME.—The Town Council has approved a recommendation of the Electricity Committee for the adoption of an assisted wiring scheme for small houses up to and including ten lights.

East Ham.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer: Mr. W. R. Elliott) for the year ended March 31st last show a total revenue of £104,190, as compared with £95,780 in the preceding year. Working expenses amounted to £74,857, as against £63,123, leaving a gross profit of £29,333 (£32,657). After deducting capital charges and capital expenditure charged to revenue, there was a net surplus of £2,857, as compared with £6,114 in 1925-26. The sales of electrical energy increased from 7,516,576 to 8,002,029 kWh, and the maximum supply demanded from 3,930 to 4,210 kW. The average price obtained per kWh rose from 2.973d. to 3.1d.

Eston.—LOAN.—The Urban District Council is applying for sanction to the borrowing of £2,500 for meters and £1,500 for services.

Glasgow.—INQUIRY.—The *Glasgow Herald* states that the Corporation Electricity Committee has appointed a special committee to investigate the whole administration of the department with a view to effecting whatever economies are possible, consistent with the highest efficiency.

Grangetown.—OVERHEAD TRANSMISSION.—The Cleveland and Durham Electric Power Co., Ltd., proposes to erect a 20,000-V overhead line from Grangetown power station to North Skelton.

Gravesend.—NEW FEEDERS.—The Corporation Electricity Committee is to lay an additional e.h.p. feeder between Rosherville sub-station and the Black Eagle, Northfleet, at a cost of £2,200. The committee reports that a.c. distributors and l.p. feeders are required between the new Northfleet sub-station in High Street and the sub-station at the Leather Bottle. The cost will be £1,500.

LOAN.—Application is being made for sanction to loans of £3,700 for mains and £293 for transformer and switchgear.

Indo-China. — HYDRO-ELECTRIC DEVELOPMENT. — Although there are immense water-power resources in Indo-China, little has so far been done in the direction of their utilisation, there being only three small hydro-electric stations with a total of less than 1,000 h.p. in the Tonkin district. It is reported, however, that the Société des Grands Travaux d'Extrême Orient has applied for a concession to establish a plant at Chobe at a point where the water of a river would be used in two stages, at the first of which it is estimated 36,000 kW is available and at the other 90,000 kW.

Irish Free State.—PEMBROKE (DUBLIN).—At a recent meeting of the Urban District Council a report from the electrical engineer concerning the strengthening of the mains in the district was considered. The scheme involves the construction of an automatic sub-station in Donnybrook, with a capacity of 250 kW, and the laying of an additional l.p. feeder to Pembroke Road. The estimated cost is £10,000. The Council has decided to refer the report to the Roads Committee, and that the Electricity Board shall be communicated with on the subject.

Kendal.—PROPOSED CHANGE-OVER.—The electrical engineer has recommended a change-over from d.c. to a.c., at a cost of about £7,500, and that new engines of about 700 kW capacity should be installed, at a cost, with the alternators, of between £21,000 and £22,000. The recommendations are to be considered at a future meeting.

Louth.—ELECTRICITY IN BULK.—At a meeting of the Town Council on August 9th, the Electricity Committee reported having considered suggested terms for a supply of electricity in bulk by the Grimsby Corporation, and it was decided to request the Corporation to submit a formal offer.

Maghull.—ELECTRICITY SCHEMES.—The Parochial Committee has accepted tenders for the Maghull and Lydiate electricity scheme amounting to £14,503, subject to sanction from the Electricity Commissioners.

Maidenhead.—NEW TARIFF.—The Town Council has decided on a two-part tariff for business premises at a fixed annual charge plus 1½d. per kWh for electricity consumed for all purposes.

Manchester.—REVISION OF CHARGES.—The following revision of charges takes effect as from the June quarter:—Extension of the present 5d. per kWh flat rate for lighting consumers: varying from 5d. per kWh for the first 5,000 kWh per annum to 2½d. per kWh for all electricity over 100,000 kWh. New compound rate for 6,600-V power supplies: (*a*) fixed charge: varying from £4 12s. 6d. for 50 kW to £3 2s. 6d. for over 1,000 kW; (*b*) running charge, based on coal at 10s. per ton, 0.275d. per kWh; (*c*) coal clause, at the rate of 0.125d. per kWh for each 10s. per ton beyond the first 10s. and *pro rata* for lesser amounts. Extension of the foregoing power tariff for night and week-end loads: (*a*) fixed charge at half the foregoing rates, subject to a minimum charge of £20 per annum; (*b*) running charge 0.2d. per kWh; (*c*) coal clause as above.

Marlborough.—LOANS.—The Town Council has applied for sanction to a loan of £2,000 for prospective extensions of the distributing system, and one of £1,092 for a feeder cable, switch panel, &c.

Newcastle-on-Tyne.—STREET LIGHTING.—Having considered the merits of electricity and gas, the Newcastle-Tynemouth Coast Road Committee has decided to light the new road by electricity, the installation cost being estimated at £5,382.

Penang.—GEORGE TOWN.—We have received from the municipal electrical engineer (Mr. T. Rogers) a copy of his report and the statement of accounts of the electricity undertaking for the year ended December 31st last. The total revenue amounted to £132,667, and working expenses were £76,627, leaving a gross profit of £56,040, to which was added interest of £911, making a total of £56,951. Capital charges absorbed £29,846, and there was a net surplus of £27,105. The capital expenditure during the year, which included £35,230 for mains and services, £24,720 for machinery and plant, and £20,276 for submarine cables, amounted to £110 899. The sales of electrical energy amounted to 8,475,154 kWh, an increase of 1,911,143 kWh as compared with the preceding year.

Plymouth.—LOANS SANCTIONED.—The Corporation Electricity Committee has received sanction to the following loans in connection with work at St. Budeaux sub-station: Building, £577; mains, £4,625; plant and equipment, £15,716.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

BATLEY.—Lighting: From 5½d. to 4½d. per kWh. Power: From 33⅓ per cent. above the basic rate to 15 per cent. above.

NELSON.—The price for electricity reduced by 1d. per kWh

HEREFORD.—Lighting: From 7d. to 6d. per kWh; slot meters, from 10d. to 8d. per kWh; telephone system, 2-part tariff, from £5 16s. 8d. per kW and 2d. per kWh to £5 per kW and 1½d. Heating: From 2½d. to 1½d. per kWh. Special tariff consumers taking over 20,000 kWh per annum, lighting and power, from 2d. per kWh to 1½d. Discount: 5 per cent. for prompt payment of accounts, instead of 2½ per cent.

CHESTER.—Lighting from 4½d. to 4½d. per kWh. Bulk supplies: From 25s. per kW demand per quarter to 20s.

TAUNTON.—Lighting: First 500 kWh per quarter, from 6d. to 5d. per kWh; next 500 kWh, from 5d. to 4d. per kWh; over 1,000 kWh, from 4d. to 3d. Heating: From 1½d. to 1d. per kWh. Power: First 2,000 kWh per quarter, from 2½d. to 2d. per kWh; next 2,000 kWh, from 2d. to 1½d.; over 4,000 kWh, from 1½d. to 1¼d.; beyond 32,000 kWh per annum, 1d. per kWh. The charges to consumers outside the borough are 25 per cent., above these figures.

STROUD.—The Stroud Electric Supply Co., Ltd., has adopted the following revised scale for lighting:—Winter quarters: First 100 kWh per quarter, 9d. per kWh; beyond, 8d. per kWh. Summer quarters: First 50 kW per quarter, 9d. per kWh; beyond, 8d. per kWh, with a minimum charge of 5s. per quarter.

BRIDLINGTON.—Lighting: From 7d. to 6½d. per kWh. Domestic purposes: From 1½d. to 1¼d. per kWh.

CROYDON.—"All-in" tariff: the "unit" charge reduced from 1d. to ¾d.

Salford.—PROPOSED CHANGE-OVER.—The Corporation has given notice of its intention to apply for consent to alter the pressure of electricity supply in cases of d.c. or single-phase a.c. supplies from 200 and 220 V to 230 V, and from 400 and 440 V to 460 V, and in cases of other a.c. supplies from 240 V to 230 V, and from 420 V to 400 V.

Sheffield.—YEAR'S WORKING.—We have received from Mr. S. E. Fedden, general manager and engineer of the Corporation electricity undertaking, a copy of his annual report, together with the statement of the accounts for the year ended March 31st last. The total revenue amounted to £776,454, as compared with £718,959 in the previous year. As a result of the coal dispute, the cost of fuel increased by £146,342, and working expenses were consequently higher at £521,431, as against £332,776, leaving a gross profit of £255,023 (£386,183), to which was added an unemployment grant of £982, making a total of £256,005 available. Capital charges absorbed the whole of the gross profit, and there was a net loss of £52,522, as compared with a surplus of £77,258 in 1925-26. The capital expenditure during the year amounted to £276,445, and included £191,530 for mains. The total now expended on the undertaking stands at £4,433,652. The sales of electricity increased from 161,339,751 to 170,213,413 kWh, and the maximum supply demanded from 76,804 to 80 852 kVA. The average price obtained per kWh slightly increased from 1.053d. to 1.076d. The length of additional feeder and distribution mains laid during the year was 145 miles, bringing the total mileage up to 1,053. The total connections amounted to 258,616 kW, an increase of 15,434 kW.

Stirling.—INSTITUTION SUPPLY.—The Board of Guardians has decided to install electricity for lighting at the Institution

at an estimated cost of over £700. The work is to be carried out under the superintendence of Mr. Inglis, electrical engineer, of Glasgow.

Stretford.—Loan Sanctioned.—The Urban District Council has received sanction to the borrowing of £20,000 for mains and services.

Sunderland. — New Sub-station. — The Corporation has decided to construct a sub-station in Pann Lane. The total estimated cost, including mains, is £5,940.

Tonbridge.—Loan.—The Urban District Council has applied for sanction to a loan of £5,000 for mains extensions.

Tunbridge Wells.—Electricity Extensions.—The Town Council has adopted a report by the borough electrical engineer advising further extensions to the generating plant at a cost of £16,043.

Wallasey. — Electricity Extensions. — The Corporation Electricity Committee has decided to order a further 12,500-kW turbo-alternator at a cost of £37,000, and to proceed with an extension scheme providing for the installation of two new boilers and auxiliary plant at a cost of £150,000. The consumption of electricity in Wallasey has increased rapidly, and the borough is now supplying Birkenhead with more energy than Wallasey itself consumed five years ago.

Wilmslow.—Purchase of Undertaking.—The Urban District Council has decided, provided the Alderley Edge Urban District Council is agreeable, to purchase the undertaking of the Alderley and Wilmslow Electric Supply Co., Ltd., and, subject to the approval of the Electricity Commissioners, to form a Joint Board to include the Urban Districts of Alderley Edge, Wilmslow, and such of the immediate adjoining districts as shall be agreed to, the Council being granted a Special Order to include a new Joint Electricity Board.

Winchester.—Year's Working.—The report on the working of the city electricity undertaking (engineer: Mr. R. Ayton) for the year ended March 31st last shows a total income of £38,174, and working expenditure of £24,479, leaving a gross surplus of £13,696. The previous year's figures were:—Income, £33,777; working expenses, £22,545; gross profit, £11,232. To the gross profit was added revenue from other sources making a total of £13,919. After deducting interest and sinking fund charges, and expenditure on works of a capital nature charged to revenue, there was a net surplus of £853, as compared with £1,727 in the preceding year. The capital expenditure during the year amounted to £17,525, and the total now expended on the undertaking stands at £167,672. The electrical energy sold increased from 1,941,926 to 2,138,311 kWh.

Tramway and Railway Notes.

Continental.—Germany.—According to the *Daily Mail*, in connection with the electrification of the Berlin local railway lines, new coaches of high-grade steel, which will be lighter than the ones now in use, have been ordered. Experiments are also being carried out on coaches of aluminium, which, it is hoped, will reduce the consumption of electricity.

Belgium.—The Société Nationale de Chemins de Fer Vicinaux, of Brussels, is preparing the necessary plans for the electrification of the railway between Antwerp and Lierre.

Switzerland.—Good progress is being made with the electrification of the Richterswil-Buchs and Sargans-Chur sections of the Swiss Federal railways. The first-mentioned section is expected to be completed before the end of the present year, and that between Sargans and Chur by May of next year.

East Ham.—Year's Working.—The accounts of the Corporation tramway undertaking (manager: Mr. W. R. Elliott) for the year ended March 31st last record a total income of £92,856, and working expenditure of £97,352, leaving a gross loss of £4,496. The figures for the preceding year were:—Income, £85,554; working expenses, £98,224; gross loss, £12,670. After payment of capital charges and rental of leased lines, there was a net deficit of £30,543, as compared with a loss of £39,512 in the preceding year. The number of passengers carried increased from 15,630,477 to 17,211,808, and the car-mileage from 1,671,515 to 1,734,858. The revenue per car-mile rose from 12.28d. to 12.84d.

Penang.—George Town.—The report on the working of the municipal tramway undertaking (manager: Mr. T. Rogers) for the year ended December 31st last records a total revenue of £35,855, and working expenses of £28,997, leaving a gross profit of £6,858. After payment of capital charges there was a net surplus of £125. The capital expenditure during the year amounted to £9,245, and the total now expended on the undertaking is £103,058. The number of passengers carried increased from 7,245,201 to 8,465,821.

The Penang Hill Railway recorded a revenue of $89,448. After meeting working expenses, capital charges, &c., there was a net deficit of $908.

Sao Paulo.—Transport Improvements.—*Modern Transport* states that the State Government has received a proposal from the Sao Paulo Tramway, Light and Power Co. for a number of city improvements costing about £2,000,000, including the doubling of single electric tramway tracks; the laying of 65 kilometres of additional track; the construction of an underground line passing through the centre of the city, in which the Prefeitura will probably participate financially; and the substitution of the latest types of passenger and freight-cars for those at present in use.

Swansea.—New Depot.—The Swansea Improvements and Tramways Co. is to convert land adjoining the station at Rutland Street between Rayner Place and Albert Place into a depôt for the accommodation of the new electric trains, and to erect permanent buildings thereon.

Thornaby-on-Tees.—Extension of Time.—The Minister of Transport has granted an extension of time for the completion of works authorised by the Corporation Tramways Order, 1919, to August 15th, 1928.

West Ham.—Year's Working.—The report on the working of the Corporation tramway undertaking (manager: Mr. L. Slattery) for the year ended March 31st last shows a total income of £264,885, as compared with £256,595 in 1925-26. Working expenses decreased from £257,841 to £253,413, and there was a gross profit of £11,472, as against a gross deficit of £1,246. After meeting capital charges, &c., there was a net loss of £30,975, as compared with £39,571 in the preceding year. The capital expenditure during the year amounted to £47,454, and included £37,704 for track reconstruction.

Telegraph and Telephone Notes.

France.—Telegraphists' Strike.—Discontented at the non-payment of certain sums granted them and fearing that the departure of M. Bokanowsky, Minister of Commerce, for America would further delay the settlement of accounts, the employés of the Paris Central Telegraph Office struck work at mid-day on August 9th. The Minister declared he could not receive a deputation till work had been resumed. The deputation was received soon afterwards by one of the Minister's officials who, however, refused to talk to two of the delegates who belong to the Extremist Union. At 5.30 p.m. the greater number of the employés had resumed work. The interruption of the telegraph service was only almost total for about an hour. During the evening the Minister of Commerce received a deputation and assured it that measures were being taken for the adjustment of salaries of civil servants in the Post Office.—*Reuter* (Paris).

Philippines.—Radio Service.—A Trans-Pacific radio service has been put into operation at Manila. The call signals range from KZAD to KIW, and normal wave-lengths from 600 to 2,701 (t.w.). The service is strictly controlled by the Government and the United States Army.—*Reuter's Trade Service.*

The Telephone Service.—Police Kiosks Advocated.—Manchester is considering the extension of the use of police telephone kiosks. It is urged that, by providing such additional communication with the police stations and by inducing the public to make their requests and complaints by telephone, the work of the police will be lightened and considerable economy effected. Major-General Sir L. W. Atcherley, H.M. Inspector of Constabulary, speaking at an inspection of the Salford police, said that the extension of police telephone facilities was essential unless they were prepared to face an increase in the police force.

Transatlantic Telephony.—Belgium.—According to *The Times*, the Belgian Telephone Administration has received authority from the British telephone service to make use of the British wireless station through which telephonic communication is effected between Great Britain and the United States. The service will be put into operation in about a week's time.

Radio Notes.

Argentina.—Radio Market.—The market for radio equipment shows signs of development, the value of apparatus and parts imported having exceeded by several thousand pesos that of last season. The number of receiving sets in use is estimated at 159,000, a large proportion being crystal sets. The market is described as particularly promising for valve sets and parts.—*Reuter's Trade Service* (Buenos Aires).

Denmark.—NUMBER OF LISTENERS.—The number of listeners continues to increase. During June there was an increase of 2,638 listeners, and on July 1st the aggregate number had reached 146,997.

Empire Broadcasting.—AN AMATEUR'S LICENCE.—Mr. Gerald Marcuse, the well-known amateur wireless transmitter, of Caterham, Surrey, has been given a licence by the General Post Office to enable him to broadcast regular radio programmes from this country to the Dominions. His programmes will be transmitted three nights each week from studios in the London area on a short wave-length. He expects to begin transmitting early next month.

B.B.C. STATEMENT.—Discussing the subject in *The Times*, Capt. P. P. Eckersley, chief engineer of the B.B.C., writes, *inter alia*, as follows:—

"Certain proposals have been made to the B.B.C. for the ostensible purpose of expediting the inception of satisfactory Empire broadcasting. After careful consideration, we have concluded that these proposals are both premature and unsound. We began experiments just over four years ago. On the transmission side we have made considerable progress. On the reception side progress has not been so rapid, and our research is still going on. The practical result of work done during these four years—and I include the experiments in Holland, the United States and elsewhere—is that at isolated moments it is possible in almost any part of the world to pick up somewhat distorted music and speech transmitted by a short-wave station. On only some of these rather isolated occasions reception is reasonably good. Neither the time nor the duration of these admittedly unsatisfactory moments of reception can be anticipated. Therefore every factor essential to service is absent, and because I have insisted upon the recognition of this fact, the B.B.C. is accused of a variety of crimes both against wireless and the British Empire. By the end of this year we shall be operating a short-wave station experimentally in active co-operation with the Radio Corporation of America and the Marconi Company, whose experience in short-wave work is far and away superior to that of any group of engineers in the world. Incidentally, the experts of the Marconi Company are in complete agreement with my views on this subject. Effective Empire broadcasting will become possible only in terms of relays through the broadcasting systems of the Dominions and Colonies. I mean by the word 'effective,' the kind of broadcasting which will enable the relays to be received with reasonable clarity by the average listener throughout Greater Britain." *World Radio* explains that the problem is one rather of reception than of transmission, and satisfactory reception involves the elimination, so far as may be possible, of fading. It is hoped that this object may be attained by the use of a number of receivers spread over a limited district, the reason being that there is a marked difference in reception even within a strictly circumscribed area. Each of these receivers would be connected to the control room at Savoy Hill. A concentration of strength may be sought in the direction of reflectors working in conjunction with the receiving aerials, after the manner of the "beam" system. It is hoped the results obtained by these methods will be applied to the B.B.C. scheme of Empire broadcasting.

Regional Distribution.—NEW STATION INAUGURATION.—To-day 80 per cent. of the population of England, Scotland, Wales and Northern Ireland is assured of an uninterrupted service of one programme. August 21st is the inaugural date of the regional scheme of distribution by which alternative programmes will be made available to all listeners. The results of the new Daventry (experimental) station (5 GB) will determine the final form of the new system. Under the international distribution of wave-lengths, Great Britain secured nine medium waves and one long wave for its broadcasting service. In order to operate 5 GB and at the same time observe the international agreement, wave-length adjustments have been necessary: 5 GB will rank as a high-power (30 kW) medium-wave station with a frequency of 610 kilocycles (491.8 metres), and the Bournemouth station will revert to 921 kilocycles (326.1 metres). Transmission from Birmingham will be suspended, but this does not mean the closing down of the Birmingham station; a large proportion of the programmes of 5 GB will originate in Birmingham, and, although the limitation of wavelengths will entail a reduction of the number of transmitters, studios will continue to be used even when transmitters cease to function; thus, 'local colour" will be retained. The B.B.C.'s plan is based on the principle of utilising five double-wavelength high-powered transmitters instead of the existing system of numerous single-wavelength low-power stations. Independent experts who have fully approved of both the principle and the plan of the regional scheme are: Dr. W. H. Eccles, F.R.S.; Prof. E. V. Appleton, D.Sc., F.R.S.; and Mr. L. B. Turner, M.A., M.I.E.E. The Postmaster-General has indicated that there is not likely to be any objection to the scheme as a whole on technical grounds, and he agrees with the B.B.C. that it should be evolved along lines of progressive experimentation, it being understood that instalments are to be introduced only as and when the anticipated improvement of service is realisable by the listeners concerned. The new station is located close to the old Daventry plant, its aerial being supported by 110-ft. masts, which are to be increased to 325 ft. in height.

U.S.A.—ANOTHER NEW YORK STATION.—A new broadcasting station has made its appearance in New York City. It is WLTH, situated on Brooklyn Heights, Brooklyn, says *World Radio*, which explains that, according to figures recently issued, the percentages of listeners in the United States using wireless receiving sets in excess of a given number of hours per week are as follows:—

0.1	per cent.	in excess of	140	hours per week.
1	,,	,,	100	,,
10	,,	,,	50	,,
20	,,	,,	45	,,
30	,,	,,	35	,,
50	,,	,,	38	,,
80	,,	,,	30	,,

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Argentina.—BUENOS AIRES.—October 5th. National Sanitation Works. Pumping machinery and electric generating plant. (A.X. 4996.)*

Australia.—MELBOURNE.—November 14th. State Electricity Commission of Victoria. Two 10,000-kW back-pressure turbo-generators and accessory plant. (July 1st.) One 40-ton single-grab, 3-motor type electrically-operating travelling crane (July 15th.)

Eight tubular steam coal driers; seven electrically-operated briquette presses; central waste coal-dust collecting system. (A.X. 4011.)*

October 24th. Armour-clad switchgear and accessories. (B.X. 3681.)*

November 21st. Five centrifugal feed pumps.

November 28th. Four h.p. water-tube boilers and accessory plant and steel work for buildings.

September 13th. Postmaster-General's Department. Automatic switching equipment. (B.X. 3658.)*

September 20th. Telephone switchboard keys and parts. (B.X. 3657.)*

September 20th. Indicators for telephone exchanges. (B.X. 3660.)*

October 11th. Harbour Trust Commissioners. Two 3-ton and two 5-ton semi-portal electric cargo cranes. (A.X. 4992.)*

Belfast.—September 3rd. Electricity Committee. 3-phase e.h.p. a.c. switchgear. (August 5th.)

Belgium.—September 7th. Belgian Post and Telegraph authorities, La Salle Madeleine, Brussels. Three lots of telephone cable for Ghent, Lokeren, and Renaix, and five lots for Verviers, Liége, Spa, Pepinster, and Aubel. Specifications Cahier des Chargés Special Nos. 3-257 and 3-269) for 12 fr. each.

Bristol.—August 25th. Board of Guardians. Electrical goods for six months. Thos. S. Lamb, clerk, St. Peter's Hospital.

Bury.—September 9th. Electricity Department. 10,000-kW turbo-alternator with surface condensing plant. (August 12th.)

Croydon.—September 5th. Electricity Department. One vertical spindle motor-driven borehole pump. (See this issue.)

September 6th. 20,000 tons of coal for use on chain-grate mechanical stokers. (See this issue.)

Edinburgh.—August 22nd. Electricity Supply Department. H.p. and l.p. steam and water pipes, circulating-water pipes, flue dust extraction plant, h.p. steam and water valves, and l.p. water valves. (July 15th.)

September 3rd. Corporation. Installation of electric lighting at three housing schemes (1,088 houses). Specifications from engineer's office, Dewar Place.

Egypt.—CAIRO.—October 12th. Egyptian Ministry of Public Works. Four Diesel alternator groups and accessories for the Atf power station. (A.X. 5028.)*

India.—September 16th. India Store Department. Three 40-kW oil-engine generating sets, with cables and accessories. (See this issue.)

Leeds. — September 17th. Electricity Department. Boiler-house equipment, including conveying plant, wharf cranes, &c., for the first section of a new generating station. (July 22nd.)

October 8th. 25,000-kW steam turbines, 3-phase alternators and exciters, surface condensing plant, &c. (See this issue.)

London.—H.M. OFFICE OF WORKS.—August 26th. Electric lighting wire and cable. (See this issue.)

Manchester.—August 23rd. Tramways Committee. Special track work. Specification from Mr. H. Mattinson, general manager and chief engineer, Corporation Tramways, 55, Piccadilly.

Newton-in-Makerfield.—August 22nd. Electricity Committee. 3,800 yd. l.p. paper-insulated lead-covered armoured cable. (August 5th.)

New Zealand.—WELLINGTON.—September 13th. Public Works Department. Two sets 110-kV outdoor switchgear for the Waikato electric power scheme. (B.X. 3579.)*

October 4th. Batteries and charging sets for Mangahao electric power scheme. (B.X. 3580.)* 50-kV lightning arrestors for Waikaremoana. (B.X. 3603.)* 11,000-V switchgear and metering equipment. (B.X. 3602.)* 50-kV lightning arrestors for Waikato. (B.X. 3605.)*

September 27th. One 15-ton electrically-operated overhead travelling crane. (A.X. 4849.)*

October 25th. 50-kV switchgear and steelwork for Waikato. (B.X. 3685-6-7-8.)* 10,000-kVA transformers for Waikato. (B.X. 3604.)*

November 24th. New Zealand Government Railways. Heating elements, complete with control gear, for electric ovens, electric water heaters, electric steam boiler. (B.X. 3649.)*

Plymouth.—August 22nd. Electricity Department. Transporter beam for coal conveyor. (August 5th.)

Preston.—September 12th. Electricity Department. Boilers, stokers, economisers, fans, chimneys, steam and feed piping for the Ribble power station. (See this issue.)

South Africa.—JOHANNESBURG.—August 29th. Municipal Council. One 75-kW rotary convertor and transformer. (B.X 3661.)*

September 8th. Railways and Harbours. Three 4-ton electrically-driven portal jib cranes. (A.X. 4991.)*

Tilbury.—September 22nd. Urban District Council. Electricity meters for 12 months. Carcassing of houses on the Council's housing estate, complete for lighting and cooking, and also for the installation of electric cookers in the houses. (See this issue.)

Wallasey.—September 17th. Electricity Department. Supply and erection of one 50-ton overhead electric travelling crane at Limekiln Lane power station. (See this issue.)

Wick.—August 22nd. Town Council. Distribution mains, services, &c., generating machinery, equipment, &c., station building, &c.; hydro-electric plant, &c. Schedules from Mr. J. E. MacEwan, 108, Douglas Street, Glasgow.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Australia.—MELBOURNE.—Postmaster-General's Department.
Cadmium copper wire (Sch. C.183) (£136,525).—British Insulated Cables, Ltd.
Condensers (Sch. C.173) (£2,582).—Telegraph Condenser Co., Ltd.
Trunk switchboard equipment for Brisbane central exchange (£4,850).—Siemens Pty., Ltd.

Sydney City Council. Accepted:—
Auxiliary power transformers (£11,224); distribution transformers (£26,590).—Electrical Plant Manufacturers, Ltd. —*Tenders.*

Barking Town.—Electricity Committee. Accepted:—
Cable (£930).—John Godden & Co.

Cumnock (Ayrshire).—Town Council. Accepted:—
Installing electric lighting at the Town Hall (£195).—Cowan & Lenton.

Egremont (Cumberland).—
Wesleyan Church electric lighting scheme.—T. S. Bell and Co. (Whitehaven).

Glasgow.—Tramways Committee. Accepted:—
V.i.r. cable.—Enfield Cable Works, Ltd.
D.c.c. wire.—British Insulated Cables, Ltd., and W. T. Henley's Telegraph Works Co., Ltd.

Gravesend.—Electricity Committee. Accepted:—
Transformer (£172).—Yorkshire Electric Transformer Co., Ltd.

High Spen.—Durham County Education Committee. Accepted:—
Electric lighting, elementary school (£170).—F. Reid, Ferens & Co.

Hornsey.—Electricity Committee. Accepted:—
Conduits.—Albion Clay Co., Ltd., and Doulton & Co., Ltd.

Leeds.—Tramways Committee. Accepted:—
Two miles trolley wire (10½d. per lb.).—Richard Johnson and Nephew, Ltd.
Electricity Committee. Accepted:—
Cable.—Macintosh Cable Co., Ltd. (£3,580); W. T. Henley's Telegraph Works Co., Ltd. (£3,098); Enfield Cable Works, Ltd. (£2,740).

London.—PARK LANE, W.—Grosvenor House, Ltd.
Lift equipment for the new buildings in Park Lane (approx. £20,000).—Etchells, Congdon & Muir, Ltd.

Plymouth.—Education Committee. Accepted:—
Electric lighting at the undermentioned schools:—
Victoria Road (£103).—W. H. Heath & Co.
Laira Green (£132).—Ashfold & Co.
Union Street (£90).—W. J. Corse & Co.

Thirsk.—Board of Guardians. Accepted:—
Installing electric lighting at the Union offices.—H. Reddin and Sons.

Wakefield.—Housing Committee. Accepted:—
Wiring 20 houses on Thornes estate (£241).—Walter Robb, Ltd.
Electricity Committee. Accepted:—
Electric tower wagon (£470).—Electromobile, Ltd.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

ECONOMY cartridge fuse.

ZENITH accumulators.

Lighting fittings with a trade mark of a lantern and the letters F.G.H.

HELIX Striplites.

A special eyelet or terminal punch used in the manufacture of wireless sets. The eyelets are punched out of a metal sheet and the wire attached in one operation.

Notes.

The Professional Classes Aid Council.

The report of the Council for the year ended on April 25th, 1927, continues the record of admirable work accomplished by this excellent body, which came into existence in October, 1914, and during the following six years dealt with 12,000 applications for help. There is still urgent need for its ministrations, for the war hit professional men very hard, and there are many unpensioned sufferers from post-war conditions who are in distress but make no parade of their trials. The Council's motto is "thoroughness of method"; it aims to set professional men and women on their feet, and has in many cases succeeded in giving them a new start. There are also people past work and incurable invalids, who can only be relieved by pensions which the Council, unfortunately, has not the means to provide. Last year there were 758 applications, and financial help was given to 163 families, whilst 369 inquirers were informed where to apply for help, and many of the remainder were given advice. During the year the school expenses of 51 children were wholly or partially met, at a cost

of £1,729. Training fees amounting to £1,213 were paid for 39 men and women, and £834 was spent on various forms of help. The income for the year ended April 25th was £9,902, leaving a balance of £1,910 over the expenditure.

An Electrically Welded Pipe Line.

What is said to be the first completely welded pipe line in the United States and the longest line of its type, 22 miles, was recently completed for the city of Vallejo, California, for the transmission of water from a new reservoir in the Gordon Valley to the City's Fleming Hill reservoir, just north of Vallejo. The line is of steel-plate construction, and all its seams are electric-arc welded. The pipe is of 24 in. diameter for 15 miles, and 22 in. for the remaining 7 miles. Of the 24-in. portion approximately 11 miles has a wall thickness of 3/16 in. and 4 miles of 1/4 in. material, whereas the 22-in. pipe has a wall thickness of 3/16 in. The complete line was built by the Western Pipe and Steel Company, using welding machinery made by the General Electric Co., of America. The total static head on the pipe varies from 100 to 400 ft., and all of the pipe was tested in the shop to 225 lb. pressure. A number of sections were tested to 325 lb. and a few to 720 lb., but no leaks developed in the welded seam. Automatic electric arc welding was used at the factory for making longitudinal seams for 14-ft. sections of pipe. Two of these sections were joined together by means of a circular weld using semi-automatic equipment. The 28-ft. sections were delivered in the field, and several sections were welded together on the surface by hand welding before being lowered into the ditch. The finished 22 miles of pipe was put under final test for 48 consecutive hours in the early part of March of last year, during which time the pipe was under a pressure of 200 lb. per sq. in. at the lowest point in the line; it was found to be absolutely free from leaks. During the filling of the line only one leak occurred in the straight seam in the entire length; nineteen girth seams showed leakage or sweats out of a total of 8,200, of which 4,100 were field joints, hand welded, and the remaining seams were shop welded with semi-automatic welding equipment. The field welding equipment used consisted of several gas-engine driven generators.

London Traffic Control.

It is understood that the report of a sub-committee of the London and Home Counties Traffic Advisory Committee, containing proposals for the co-ordination of passenger transport services in the Greater London area, has been adopted by the main body, with a view to its presentation to the Cabinet.

132-kV Underground Cable in America.

The world's first underground 132,000-volt electrical transmission line to be put into regular commercial service commenced operation in Chicago recently on the system of the Commonwealth Edison Company. The installation starts a new chapter in the history of electrical development, according to Mr. Samuel Insull, president of the company. The new line, *Power* explains, is six miles long, joining 132,000-volt overhead lines of the Public Service Co. of Northern Illinois at the city limits. It consists of underground conduits containing three lead-sheathed cables, each slightly more than three inches in diameter. The core of the cable is hollow and is surrounded by copper wires which in turn are wrapped with paper, the whole being covered with a protective metal sheath. The hollow core is filled with oil under pressure, the oil impregnating the paper. Elevated oil reservoirs placed at intervals along the line keep the core filled and under pressure.

Carbon Dioxide in a Mercury Interrupter.

It is customary to use coal gas as a dielectric in the mercury interrupter and it has generally been found to be quite satisfactory in action. There are, however, places where coal gas is not available, and experiments undertaken with the view of examining the possibility of employing carbonic acid gas in connection with X-ray work carried out in hospitals at such places are described in *Nature* by Messrs. G. R. Paranjpe and H. D. Tendulkar, of the Royal Institute of Science, Bombay.

Carbonic acid gas is available in cylinders at many places, and, being an inert gas, it naturally suggests itself as a very useful substitute for coal gas. Since the most important function of the dielectric is to extinguish the flame, it is necessary to examine its action when it is employed in an interrupter in two different circumstances: in one case, when the primary of the induction coil is connected up straight to the source of electric power which gives just sufficient potential difference in the primary to obtain the desired e.m.f. in the secondary, and in the second case, when the primary draws current from the supply mains through a large rheostat which regulates the current in the primary to yield the desired e.m.f. in the secondary. In the first case, the sparking inside the interrupter is considerably less than in the second case, where the whole potential difference of the supply mains is effective in producing the spark at the break.

It is shown that in either case, when hydrogen or carbonic acid gas is used, the efficiency of the interrupter is greater than when coal gas is used. Hydrogen gives the longest spark-gap, that is, the highest value of the secondary e.m.f. with the smallest potential difference in the primary. The difference between the working of the gas-mercury-interrupter using coal gas and carbonic acid gas is less in the case when the full 230 volts is allowed to play across the break than when the potential difference at that point is carefully adjusted to the minimum to yield the required e.m.f. in the secondary as indicated by the length of the spark-gap. The results show that it would be more economical to use carbonic acid gas, since to obtain equal e.m.f.'s in the secondary, less electric power is required in the primary.

Carbonic acid gas, being heavier than air, is capable of easily displacing the air from the interrupter, and the fact that the interrupter is full of the gas can be easily tested. The gas itself is of course harmless. Further points in connection with this gas are that it has no action on the electrodes and the gas remains unaltered after long use.

Automatic Mercury-arc Rectifiers.

The rehabilitation of the Chicago, South Shore, and South Bend Railroad, which was undertaken in the summer of 1925, has progressed to the point where the power supply system has been rebuilt and most of the new equipment has been placed in service. The electrical equipment has been changed from 6,600 volts alternating current to 1,500 volts direct current, which change permits the operation of South Shore trains with their own equipment directly into the Chicago terminal area, although the trains run over the tracks of the Illinois Central Railroad from Kensington (Ill.) to the Loop District of Chicago. The Illinois Central railroad has placed its Chicago terminal electrified system in service, the 1,500-volt direct-current system being used. Power supply for the South Shore lines is obtained from a 33,000-volt line which feeds eight sub-stations located along the right-of-way; in them the voltage is stepped down and converted to 1,500 volts direct current. So far as is economically feasible, automatic control equipment has been employed in the sub-stations. Where the presence of attendants is necessitated by other considerations, partial automatic control has been installed. A feature of the system is the use of mercury-arc rectifiers in four of the eight sub-stations, which represents the first application of 1,500-volt rectifiers and of 1,500-volt automatic rectifier control in the United States. Many of the elements of the control parallel very closely those which have been used for some time in railway sub-station control equipment, the plant being started and stopped in accordance with load demand in an identical manner. Two sub-stations contain two partially-automatic 750-kW rotary convertors in series each; two contain two automatic 750-kW machines in series each; three contain one 750-kW automatic mercury-arc rectifier each, and the remaining sub-station contains two 750-kW mercury-arc rectifiers operating in parallel as a single set; each rectifier consists of a single tank rated at 500 amperes at 1,500 volts. According to the *General Electric Review*, the control apparatus is no more complicated than that needed for rotating machinery, and it operates with the same reliability.

Appointments Vacant.

One senior salesman (£5), one junior salesman (£3 10s.), one lady demonstrator (£4) for the Battersea Borough Council electricity showrooms. Lady tracer (35s.) for H.M.S. *Vernon*. Junior technical officer (£266) for the Royal Aircraft Establishment, South Farnborough. Shift charge engineer and two sub-station attendants for the Borough of Colchester Electricity Department. Power station engineer and chief traffic inspector for the East London (S.A.) Corporation Electricity Department. Electrician (£4) for the Bolsover Urban District Council. Assistant mains engineer (£304), and assistant draughtsman (£222), for the Islington Borough Council Electricity Department. (See our advertisement pages to-day.)

A Large Gas Engine.

The second of a set of three engines, claimed to be the largest of their kind in England, was recently set in motion at the Devonshire works of the Staveley Coal & Iron Co., Ltd., in Derbyshire. Each set consists of a 7,150-h.p. gas engine weighing 700 tons (the crankshaft weighs 80 tons) driving electricity generating plant and fed with exhaust gas from the blast furnaces, which would otherwise be wasted.

A National Bureau of Information.

In an article in *Nature* under this title, Dr. S. C. Bradford, of the Science Library, South Kensington, London, describes the resources of the Library, which for some years has been organising an information service covering the whole field of science and technology. It possesses a large and increasing collection of the scientific literature of the world, both books and periodicals, which are available for consultation in the Library or for loan to scientific institutions and research associations in Great Britain. It contains more than 6,000 of the scientific and technical journals recorded in the "World List," and, together with the older series and those acquired after the marking of the List, now possesses more than 7,000 such periodicals, which are being added to at the rate of about 1,000 periodicals annually.

A comprehensive subject-matter card-index to papers in scientific and technical books and periodicals, to be used as a key to recorded information and for the supply of lists of papers on given subjects, which will soon include about one and a quarter million cards, is classified according to the Brussels extension of the Dewey decimal classification. This system is the one which has been most widely used, and is the most convenient for indexing scientific literature on a large scale and in the greatest detail.

By this autumn the preparation of the subject-matter index

will have advanced sufficiently for it to be made available to the public; it will then contain about 61,000 references in electrical engineering, 2,700 in telegraphy and telephony, 45,000 in motors, machine tools and workshop practice, 39,000 in steam and locomotive engineering, and so on—well over a million references in all.

Those who are engaged in literary researches on technical and scientific subjects will do well to make themselves acquainted with the resources of this very fine Science Library.

An Electric Sieve.

International Combustion, Ltd., has recently introduced into this country the "Hum-Mer" electric screen, which is claimed to be the only one to apply commercially electromagnetic vibration to a wire-cloth screening surface. The powerful vibration results in a sorting action which effects the maximum separation of the fine material from the coarse, and also allows of a large tonnage capacity; by the adoption of electric power an adjustable screen vibration is obtained, and the user can therefore regulate its intensity to suit the condition of his material. In the case of a varying moisture content, it is possible to increase the vibration as the moisture increases. The electrical vibration moves the material at any angle, but for large tonnage the angle usually ranges from 28 to 35 degrees. The vibrator is placed above the screening surface, free from contact with the material being screened, and enclosed in dustproof metal housing. Amongst the materials to which the electric screen has been applied are fuller's earth, sugar, copper ore, sand and gravel, coal, foundry sand, limestone, salt, phosphate rock, stone of various kinds, cement, clay or shale, &c. The vibration is obtained by the use of low-frequency alternating current, and only from 3½ to 4 amp. is consumed by the standard vibrator.

Official Pilgrimage to Volta Centenary Celebrations.

The C.I.T., the official Italian Tourist Organisation, announces that in September an international party will be participating in an official visit to Italy in connection with the Volta Exhibition, which is being held at Como. Other places will be visited, including Florence, Pavia, Milan, Rome, the Apennines and the lakes (Como, Maggiore, Lugano, Garda). The organisation of this tour owes its inception to the initiative of the Hon. E. M. Gray, president of the C.I.T., and Professor A. Mieli, of the Rome University. The journey will be conducted under the auspices of the National Institute of History and Science. The inclusive cost of the 15 days' tour from Florence until the termination in Rome will be about £12, including all travel and hotel expenses. Special reduced terms for railway travel in Italy have been obtained and accommodation will be provided at good second-class hotels. Full details will be provided upon application to the C.I.T. and Italian State Railways, 16, Waterloo Place, Regent Street, London, S.W.1.

Fatality.

An inquest was held at Kilburn on August 9th into the circumstances attending the death of Victor Richard Brooker, who received a fatal electric shock whilst employed at Brown's Garage, Cricklewood, on August 6th. Evidence was given that deceased came into contact with a defective electric switch and received a shock at 240 V. A verdict of "Death by misadventure, through a defective electric fitting," was returned.

Rural Electrification in Germany.

In an article in *Commerce Reports* some particulars are given concerning rural electrification in Germany. The most highly electrified districts are given as Silesia, Saxony, and Pomerania, largely due to the activities of electrical co-operative organisations. It is estimated that electricity could be available at from 50 to 60 per cent. of all the farms in Germany, and that the percentage of electrified farms in districts where electricity supply is available is about 70 or 80. The existing rates are no great obstacle to the use of electricity on farms, provided that the cost of the connection to the power line is not too great a burden on the farmer. Difficulties in this connection are usually overcome by the co-operative associations. The Berlin municipal undertakings quote a rate of 9.5 cents per kWh to rural consumers without any fixed charges. For night consumption much more favourable rates are quoted. The Governments, national and local, are not paying any particular attention to the development of farm electrification; more consideration is being given to the proper location of plant and to the utilisation of a cheap power supply at its source. The largest power plants in Germany are either operated or controlled by the Federal or State Government, or they hold stock in the operating companies, together with private capital. There are now 6,110 electric power co-operatives operating in Germany, of which 3,148 are banded together under the Federal Association of German Agricultural Co-operatives. Some of these bodies carry out the connection of a particular district with a near-by power line, including the installation of a transformer station. Others do this work in addition to electrifying the farm. Some operate their own generating stations, while finally there are groups which buy electricity in bulk and retail it to members. The Federal Government does not directly advance money to the co-operatives; in most instances the necessary funds are raised by contribution from the members and by credits obtained from co-operative farmers' banks. In some cases a rural municipality will arrange with a power company with near-by lines to have a large transformer station installed and a sub-distribution line brought into the heart of the district to be electrified. In such cases the municipality guarantees a certain minimum consumption within the district.

Tidal Power Stations in France.

The Commercial Counsellor at Paris (Mr. J. R. Cahill, C.M.G.), has reported to the Department of Overseas Trade that the proposed tidal power stations in France were the subject of some discussion at the recent annual meeting of the French company L'Azote Française, which participates in the Société Technique d'Etudes et d'Entreprises pour l'Industrie, which has been preparing plans for the tidal station at Aber-Wrac'h in Finistere. The report presented to the shareholders states that the Société will not only utilise the tides at Aber-Wrac'h, but also intends to create more important stations in foreign countries. For these purposes it has founded the Societe Internationale pour l'Exploitation Industrielle de la Houille Bleue, to which it has made over its patents and the results of its investigations. In a speech delivered at the meeting the chairman of the Azote Français reviewed at some length the history of efforts to utilise the tides and the technical problems involved. In reply to a shareholder who asked whether the Aber-Wrac'h station was simply an experimental station, or could be regarded as an industrial works, the chairman said that plant of 6,000 kW was more than an experimental station and might be regarded as a works. Semi-industrial experiments had been made in order to study the value of the turbines, and their results allowed him to declare with certainty that the problem had been completely solved. The chairman went on to say that the plans at Aber-Wrac'h were completed and that the only obstacle which had prevented them from realising their scheme two years ago was finance. They evidently required to issue bonds guaranteed by the State, but for some time it had been impossible to place them on the market. Work at Aber-Wrac'h would begin in October and he hoped that in two years' time they would be able to attend the inauguration of the station. He thought that there was no need to await the results of Aber-Wrac'h before starting similar stations abroad. There was an American and Canadian scheme for a station on the frontier between Canada and the United States. In France they were studying the question of a station on the Rance on a site where the problem had been investigated so long ago as in the reign of Louis XIV. Another scheme was to install a 150,000-kW station about 100 kilometres from Paris.

Electroculture.

The Berlin correspondent of the *Daily Mail* states that Herr Fritzsche claims to have been very successful at his testing grounds at Alt Kleinetke, where he is experimenting with the electroculture of crops. Herr Fritzsche has also cultivated with the help of his electrical process patches of sugar beet, maize, and soya-bean, which all promise well. The British Government has asked him for full particulars of the cultivation of sugar beet by means of the electrical process.

Magneto Successes.

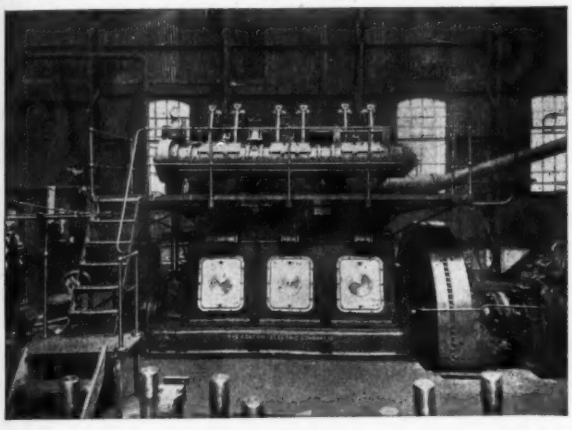
We learn that important awards in the Scottish Six Days Trials were secured by motor-cycles fitted with B.T.-H. magnetos. The Douglas machines, which were in the winning team for the manufacturers' team prize for 350 c.c. solo mounts and two of the three Triumph sidecar combinations in the same team were equipped with magnetos of this make. Of the special awards, one fell to a 247 c.c. Levis, one to a 249 c.c. Dunelt, and one to a 348 c.c. Douglas, while 13 silver cups, three gold medals, five silver medals, and a bronze medal were awarded to riders whose machines were fitted with magnetos manufactured in Coventry by the British Thomson-Houston Co., Ltd.

London's Power Supply.

In view of the unofficial statements which have recently appeared in the daily Press, the Management Committee of the London Power Co., Ltd., has authorised the following account of the work which it has in hand. The company is actively engaged in co-ordinating the generation and transmission of electrical energy at 22,000 volts within its area of supply, with a view to meeting the requirements of its constituent companies and any other authorised undertakers which it is expressly empowered by statute to supply until the year 1971, when its franchise terminates. The programme of works now being carried out includes the extension of the existing generating stations at Bow, Grove Road, Willesden and Deptford by some 220,000 kW of plant, to be completed by the winter of 1929-30, and the laying down of a 22,000-volt transmission system to interconnect all the above-mentioned stations, which will supply the ten constituent companies and other authorised undertakers. Some of the older generating stations of the constituent companies will be closed down as the new plant comes into commission this autumn, and bulk supplies will be furnished at 22,000 volts. The company has quite recently received authority to erect a generating station at Battersea, for an ultimate capacity of 360,000 kW, the first section of which will, it is expected, be brought into commission for the winter of 1931-32.

A Low Fuel Consumption Installation.

An interesting electricity extension has recently been completed for the Pembroke Urban District Council, Dublin, comprising an 850-b.h.p. Fraser & Chalmers oil engine coupled to a 590-kW "Witton" G.E.C. generator; the engine is incidently claimed to be the largest one of its type to be put to work in Ireland. This installation was specially recommended by virtue of its low fuel consumption; it was pointed out by Mr. Price, the engineer, at the opening ceremony that electricity would be generated at approximately 1d. per kWh. The acceptance trials proved that the fuel consumption of crude petroleum was .56 lb. per kWh at full load, and .57 lb. at three-quarter load. The economies to be effected by this type of plant show in comparison a distinct advance in oil-engine efficiency. The engine in question is a 3-cylinder unit of the standard type developed by the makers of capacities 850- to 2,300-b.h.p., the bore and stroke being common over this range of power. It embraces a number of interesting features. All the metals subjected to the combustion temperature are of special steels or alloys to produce a rapid heat flow to the



An Economical Oil-Engine Installation.

water jackets from the combustion chamber or cylinder, thus reducing the heat stresses in all the members and consequently adding to the thermal efficiency of the engine. It is claimed that the piston is free from the possibility of seizure, as the metals used cannot fuse or weld together should the oil supply fail. Should the lubricating oil pressure fall below a certain figure, the engine will automatically come to rest, and the same happens in the event of the speed rising 10 per cent. above normal. During the trials the engine and dynamo carried a total load of 650 kW (60 kW overload) without any signs of overstrain.

The Cattley Accumulator.

An interesting storage cell has been brought to our notice by the Cattley Accumulator Co., Ltd., of Llandaff; it is of the lead type, with a pasted positive plate of annular shape surrounding a cylindrical negative electrode, in a celluloid container provided with an "unspillable" vent, the whole weighing 4 lb. The special feature is the negative, which has no grid, and is a porous mass made by a patented process; the cylindrical form is designed for miners' lamps, but it can be made flat for plates or in strip form for wireless batteries. It is claimed that the negative is not affected by sulphating, even when the cell is left discharged, and that it possesses great capacity, maintaining a miners' lamp alight for twice the duration achieved with the cells usually employed; and that short-circuiting also has no permanent effect. The cell is stated to have a capacity of 19-20 Ah at 0.9 A discharge, and 16-18 Ah at 2 A.

A test made by the National Physical Laboratory shows that discharging at 0.9 A, down to 1.8 V, a capacity of 18.9 Ah was obtained; a cell which we have had under observation for some time, after standing discharged for a month, was charged and gave a similar result. The cell retains its voltage over long periods, although discharged, and appears to be capable of withstanding the effects of ill-usage and neglect. The density of the electrolyte recommended by the makers is higher than usual, attaining 1.300 at the end of charge.

Institution Notes.

Institution of Public Lighting Engineers.

The annual conference will be held at Brighton on September 12th to 15th next, when a full programme will include the presentation and discussion of a number of papers and a variety of social events. The business proceedings provide, *inter alia*, for the president's address, by Mr. Alex. C. Cramb, M.I.E.E., engineer and manager, Croydon, a joint descriptive paper of the British Engineering Standards Association's "Standard Specification for Street Lighting," by Capt. L. B. W. Jolley, M.A., M.I.E.E., research engineer, and Mr. J. M. Waldron, G.E.C. research laboratories, Wembley, and Mr. Robert Watson, engineer and manager, Gas Department, Doncaster, and a paper descriptive of the public street lighting of Brighton, by Mr. J. Christie, M.I.E.E., engineer and manager, Brighton. An exhibition of public lighting appliances will be open daily during the conference.

An Empire Mining Congress.

On Saturday last the s.s. *Alaunia* left Southampton bearing a large party of delegates to the second Empire Mining and Metallurgical Congress, which is being held in Canada; it will open on August 22nd in Montreal, and will last until September 28th. During that period, says the *Financial News*, two simultaneous tours in special trains will be made; one will visit the principal mining centres of Ontario, Quebec, and Western Canada, while the other will travel through Ontario with the first, but will then take a separate course to examine the mining areas of Quebec, Eastern Canada, and Newfoundland. Technical sessions are to be held at Montreal, Toronto, Winnipeg, Sydney, Vancouver, and Edmonton.

The convening body for this congress is the Canadian Institute of Mining and Metallurgy, and the 10 institutions composing the congress include the Institute of Metals, the Institution of Mining Engineers, the Institution of Mining and Metallurgy, the Iron and Steel Institute, the Institution of Petroleum Technologists, the Chemical, Metallurgical and Mining Society of South Africa, the South African Institution of Engineers, the Australian Institute of Mining and Metallurgy, the Mining and Geological Institute of India, and the Canadian Institute of Mining and Metallurgy.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. A. E. ANDERSON, of Amble, has been appointed manager of the Walton (Surrey) electricity undertaking, which the District Council is to take over on October 1st.

Mr. E. J. ELDRIDGE retires under the age limit on September 30th from the post of superintending engineer of the Post Office Engineering Department, South-Western District, and Major W. M. BATCHELOR has been appointed to succeed him.

Mr. F. H. WHYSALL, who is leaving Greenock to take up his new duties as city electrical engineer of Belfast, was the guest of honour at a complimentary dinner arranged recently by electrical engineers in the West of Scotland. Mr. E. T. Goslin, general manager, Clyde Valley Electrical Power Co., occupied the chair, and he was supported by Messrs. W. C. Bexon, general manager, Ayrshire Electricity Board; W. L. Winning, chairman, Scottish Centre, I.E.E.; W. Blair Smith, burgh electrical engineer, Paisley; D. McDougall, chief assistant engineer, Greenock Electricity Department; G. H. Rowbottom, sales manager, Clyde Valley Electrical Power Co.; A. E. McColl, representing the Central Electricity Board; J. A. Robertson, consulting engineer, Manchester (formerly burgh electrical engineer of Greenock); D. Macarthur, Metropolitan-Vickers Electrical Co., Ltd.; P. N. Rand and W. Sutcliffe, English Electric Co., Ltd.; R. Kellan, General Electric Co., Ltd.; A. D. McKinnon, British Thomson-Houston Co., Ltd.; and H. W. Bewsher, Babcock & Wilcox, Ltd. Mr. Whysall was presented with a gold cigarette case, and the speeches which followed showed the great esteem and affection in which he is held by his colleagues. Another ceremony took place at the Electricity Works in Dellingburn Street, Greenock, when Mr. D. McDougall, chief assistant engineer, conveyed good wishes for his future success, and presented Mr. Whysall with a handsome canteen of cutlery from the employés of the Department. A further tribute was paid by the local electrical contractors at the close of a business meeting.

Mr. J. N. COPPING has been appointed chief mechanical and electrical engineer to the Bolsover Colliery Co., Ltd. For the past seven or eight years Mr. Copping has been chief engineer to the Fife Coal Co., Ltd., whose plant was described in the ELECTRICAL REVIEW of September 4th, 1925. Mr. Copping is president of the East of Scotland branch of the Association of Mining Electrical Engineers.

Mr. JAMES MAKIN, who has been electrical engineer to the Hereford City Corporation since 1922, has been appointed chief engineer and general manager of the Altrincham (Cheshire) Electric Supply Company, at a salary of £1,200 per annum, and will take up his new duties shortly.

Obituary.—COUNCILLOR W. B. LINDSAY.—Councillor William Bruce Lindsay, who has died suddenly, was for eight years convener of the Edinburgh Corporation Electricity Committee. He was associated with the construction of the Portobello power station.

MR. J. MILLIGAN.—The death has occurred at Bournemouth, on August 9th, of Mr. John Milligan, who was for many years a director of Mather & Platt, Ltd. He was 88 years of age, and joined the staff of Mather & Platt at the age of 18 years.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Sloan's Accessories, Ltd.—Registered August 4th, in Edinburgh. Capital, £10,000 in £1 shares. Objects: To carry on the businesses of manufacturers of and wholesale or retail dealers in fittings, accessories, and electrical or gas appliances, engineers, &c. The minimum cash subscription is £5,000. The first directors are:—J. R. Rust, 72, Hamilton Place, Aberdeen, granite merchant; J. Graham, 39, Albyn Place, Aberdeen, motor hirer; G. Donald, 245, Queen's Road, Aberdeen, spirit merchant; P. Sloan, 3, Mearns Road, Clarkston, Glasgow, merchant. Registered office: 1, East Crabstone Street, Aberdeen.

Armstrong-Whitworth Sales Corporation, Ltd.—Registered as a private company on August 6th, with a nominal capital of £100 in £1 shares. The objects are to manage, direct and conduct the sale or marketing of any products, materials and things manufactured, produced or belonging to others: to carry on the business of hydraulic, electrical and general engineers, &c. The first directors are:—J. F. Taylor, Doonside, Cobham, Surrey; J. P. Davison, Charnwood, Court Lane, Dulwich, S.E.21, naval architect; J. Hawson, 25, Thirlmere Road, Muswell Hill, N.10, C.A. (all directors of Sir W. G. Armstrong, Whitworth & Co., Ltd.). Registered office: Elswick Works, Newcastle-on-Tyne.

Engineering Services, Ltd.—Private company. Registered August 6th. Capital, £100 in £1 shares. Objects: To carry on the business of mechanical and electrical engineers, &c. The subscribers (each with one share) are:—Mrs. A. Hooper, Mazingarbe, Broad Oaks Road, Solihull; H. Howells, Plermont, Gresham Road, Hall Green, secretary. The first directors are H. Hooper and H. Howells. Secretary: H. Howells. Registered office: 14, Cherry Street, Birmingham.

Century Lamps (London), Ltd.—Private company. Registered August 6th. Capital, £500 in £1 shares. Objects: To carry on the business of electricians, manufacturers, and sellers of, agents for and dealers in all kinds of electric lamps, electric heating and cooking apparatus, electric signal devices, wireless apparatus, &c., to acquire the business carried on at 3, Great Winchester Street, E.C., as the Century Electric Lamp Co. The subscribers (each with one share) are:—A. S. Weston, Gaisford House, Gaisford Street, N.W.5, dentist; W. G. C. Pleass, 41, Gaisford Street, Kentish Town, N.W.5, traveller. The first directors are not named. Secretary: A. Messik, 124, Minories, E.1. Registered office: 3, Great Winchester Street, E.C.2.

London Switch-Plate Co., Ltd.—Private company. Registered August 6th. Capital, £600 in £1 shares. Objects: To carry on the business of electricians, electrical engineers, mechanical engineers, &c The directors are:—G. H. Pizer, 1, Barnstaple Mansions, Rosebery Avenue, E.C.1; Mrs. Mary A. Bancroft, 40a, Hyde Park Gate, S.W.7. Registered office: 15, Percy Street, Tottenham Court Road, W.1.

Edward Norman, Ltd.—Private company. Registered August 8th. Capital, £1,000 in £1 shares. Objects: To carry on the business of electrical, mechanical, hydraulic and pneumatic engineers, &c. The subscribers (each with one share) are:—E. J. H. Norman and F. H. Hedgeland, 23, Budge Row, E.C.4, engineers. The first directors are not named. Secretary: F. G. Hedgeland.

Sigma Electrical Manufacturing Co., Ltd.—Private company. Registered August 10th. Capital, £2,500 in £1 shares. Objects: To carry on the business of tube drawers and manufacturers of all kinds of tubes and malleable fittings for all purposes, manufacturers of and dealers in all kinds of electrical and gas fittings, &c. The directors are:—G. W. Sparrow and H. C. Kelley, 3, Newhall Street, Birmingham; W. Preece and W. Newey, addresses not stated. Solicitors: Howard Cant and Cheatle, 33, Newhall Street, Birmingham.

W. T. Canning & Co., Ltd.—Private company. Registered August 11th. Capital, £2,000 in £1 shares. Objects: To acquire the business of builders, decorators, electricians, contractors, electrical, mechanical and general engineers, wireless instruments, animated, mechanical and electrical display specialists, and general agents, now carried on by S. T. Hurley and W. Canning, at 47, Goldhawk Road, W.12, and 1a, Shepherd's Bush Road, W.6. The first directors are:—S. T. Hurley (permanent chairman), Briar Lodge, Askew Road, Shepherd's Bush, W.12; W. Canning, 40, Hatfield Road, Bedford Park, W.12. Solicitors: Hargrave, Son and Barrett, 24, John Street, Bedford Row, W.C.1. Registered office: 47, Goldhawk Road, Shepherd's Bush, W.12.

Eltron (London), Ltd.—Private company. Registered August 10th. Capital, £1,000 in £1 shares (750 "A" and 250 "B"). Objects: To carry on the business of merchants, manufacturers, brokers, importers and exporters of immersion heaters and other domestic and industrial heating appliances, electrical appliances of all kinds, and merchandise of every description, and to adopt an agreement with Theodor Herman Stiebel. The directors are:—H. E. Poole, 25, Basing Hill, N.W.11, paper and hardware merchant; T. H. Stiebel, 36, Reichenberger Strasse, Berlin, manufacturer of electrical apparatus; H. H. Williams, 28, Northampton Park, N.1, hardware merchant. T. H. Stiebel and H. E. Poole are permanent. Solicitors: Beaumont, Son & Rigden, 33, Chancery Lane, W.C.2. Registered office: 89, Blackfriars Road, S.E.1.

Official Returns of Electrical Companies.

Cambridge Electric Supply Co., Ltd.—Satisfaction in full on June 28th, 1927, of mortgage dated December 12th, 1906, and transfer dated January 30th, 1919, securing all moneys due or to become due.

English Electric Co., Ltd.—Deed of further security dated July 21st, 1927 (supplemental to trust deed dated September 15th, 1919, securing an issue of 5½ per cent. sinking fund first mortgage debentures, for £1,000,000), charged on certain lands formerly part of Grange Farm, Calverley, Yorkshire. Trustees: Debenture Corporation, Ltd., Worcester House, E.C.

Electrical Finance and Securities Co., Ltd.—Trust deed dated July 29th, 1927, to secure £100,000 debenture stock, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Second Consolidated Trust, Ltd., Dashwood House, 69, Old Broad Street, E.C.

Houghtons Electrical Engineering Co., Ltd.—F. Tingle, of Gilbert House, Princeton Street, Bedford Row, W.C.1, ceased to act as receiver on July 20th, 1927.

Minehead Electric Supply Co., Ltd.—Satisfaction in full on April 30th, 1927, of mortgage debenture dated October 12th, 1922, securing £4,500.

Hammersley Brothers, Ltd.—R. W. Beken, of 213, Hoe Street, E.17, was appointed receiver and manager on August 2nd, 1927, under powers contained in debentures dated March 8th and July 13th, 1926, and March 2nd, 1927.

Parsons & Hodges, Ltd.—Satisfaction in full on July 20th, 1927, of mortgage dated January 16th, 1927, securing £1,400. Mortgage dated July 22nd, 1927, to secure £2,110 10s., charged on freehold land and a dwelling house thereon, No. 63, The Parade, Leamington, and workshops in rear. Holders: Trustees of the Leamington, Warwick and South Warwickshire Permanent Benefit Building Society, 23a, Regent Street, Leamington Spa.

Lancashire Electric Light and Power Co., Ltd.—Trust deed dated July 21st, 1927, to secure £1,000,000 5 per cent. redeemable debenture stock, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees:—Sir Bernard E. Greenwell, Bt., 2, Finch Lane, E.C., and C. F. Campbell, 9, King William Street, E.C.

Cumberland Waste Heat Owners Co., Ltd.—Debenture dated July 8th, 1927, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Midland Bank, Ltd.

Omega Lampworks, Ltd.—Satisfaction to the extent of £1,000 on October 27th, 1926, of debentures dated February 4th, 1925, securing £1,500. (Notice filed August 2nd, 1927.)

Magneto Repair Depôt and Motor Works (Christchurch), Ltd.—C. R. Blissett, of Waterloo Chambers, Fir Vale Road, Bournemouth, ceased to act as receiver on July 25th, 1927.

City Notes.

Richardsons, Westgarth & Co., Ltd.

Mr. S. T. Coulson, the chairman, speaking at the annual meeting held at Hartlepool, on August 9th, said that during the past year their output had been the lowest on record, and they were not surprised that a loss was incurred. They had a strong cash position, a well-filled order book, and had good grounds for anticipating large orders. Therefore they recommended a dividend of 6 per cent. for the year ended December, 1926, on the ordinary shares. Experts stated that their new design of Diesel oil engines was a distinct advance on any existing type. The speaker went on to refer to another important side of their business—electrical land equipment. Having experienced a period of acute depression in shipbuilding, it was, some years ago, thought well not to confine operations to the building of marine engines. Accordingly, through the foresight of both the late Lord Furness and the late Sir Thomas Richardson, the Hartlepool Works were enlarged to enable them to build turbines and condensing plants for power stations. In these an important business had been developed and a high reputation earned. Since 1904 they had built steam turbines for some of the largest municipal corporations and public bodies, varying in size up to 25,000 kW. Among other orders now on the books, they were building large turbine plants for the London Power Co., Ltd., and the Brighton Corporation. An important part of a land plant was the electric generator. In the past they had not manufactured generators, a disability which had often prevented them from obtaining important orders. To design a new generator would entail a long experimental period, involving heavy cost; therefore, they had now entered into an agreement with their old friends, Messrs. Brown, Boveri and Co., the Swiss manufacturers of electrical plant, whose reputation for efficiency and excellence of mechanical design was world-wide. This agreement gave them the exclusive right to manufacture in this country steam turbines and electric generators, according to Brown, Boveri patents. In the past their business from abroad for this class of work had been small, but as a result of this agreement they anticipated large orders for the British Dominions and the Colonies, in addition to the home trade. They therefore regarded this agreement as a development of the highest importance. During the past year they had been making successful efforts to regain their business in "Nesdrum" water-tube boilers, de-aerating and evaporating plants, generative accumulators, &c., and there was every prospect of increased sales in this department.

Enfield Cable Works, Ltd.

The annual meeting was held on August 12th. Lord Verulam, who presided, in presenting the report and accounts (*vide* our last issue, p. 275), said that in spite of a reduction of about £14,000 in the profit the company had earned 31 per cent. on the ordinary capital after providing for depreciation, directors' fees and preference dividend. The lower profit was solely due to the reduction in the turnover as a result of the coal dispute. The company had escaped the more serious effects which were at one time considered inevitable. Almost the whole of the increase of £52,000 in the balance sheet item "land, buildings, plant, &c.," was accounted for by the installation of up-to-date plant for the much-discussed "super-tension" cable. They were satisfied with the progress made by their subsidiary, the Australian Cable Works, which was securing a fair share of the Australian business. The rolling mill plant was working very well, and turning out rods to customers' satisfaction. The company could confidently look forward to securing a share in any future prosperity experienced by the cable industry proportionate to that which it had enjoyed in the past. The report and accounts were adopted.

Puebla Tramway, Light and Power Co.

The accounts for 1926, as quoted in the *Financial Times*, show that there was a net profit in Mexico of $1,464,684 Mex., as compared with $1,363,155 Mex. for 1925. At 24.5 per peso, this is equivalent to £149,520, against £139,155. After meeting all expenses, including loss on exchange, providing for contingencies, meeting interest and sinking funds on the prior lien and first mortgage bonds and the 8 per cent. service notes, £19,314 remains to be carried to the balance sheet. It is stated that the outstanding question of State taxes has been settled on terms considered favourable to the company. "In August last the assets of the urban tramway system were, with the consent of the trustees for the bondholders and the approval of the holders of over two-thirds of the first mortgage bonds, transferred to the Puebla State Government on terms which the directors consider satisfactory. The value of the assets transferred is small compared with the amount of depreciation provided to date, and consequently no adjustment has been made in cost of properties, &c."

German Companies.

Allgemeine Elektricitäts Gesellschaft.—The board has decided to increase the company's share capital by 30,000,000 marks. At present the capital consists of 120,000,000 marks in ordinary shares, 17,500,000 in "A" preference shares, and 18,750,000 marks in "B" preference shares. The present shareholders are to be offered the new capital at the price of 140 per cent. The directors, commenting upon the prosperity of the business, state that the orders in hand are 60 per cent. above those for last year.

The Rhenish-Westphalian Electric Power Corporation.—An issue of $15,000,000 of 6 per cent. gold bonds was made on behalf of this company in New York last week, and was heavily over-subscribed. The bonds were offered at 95¼ per cent. Over $4,000,000 of the issue was reserved for distribution to other countries, including Holland and Sweden.

Rees Roturbo Manufacturing Co., Ltd.

The report for the fifteen months ended December 31st last records a debit balance of £20,410, after writing off obsolete plant and bad debts, as compared with £8,436 for the previous twelve months, making the total debit £30,768. The works and office staffs have been reorganised. Mr. W. B. Briggs has been appointed chairman, and Major C. A. Mander has joined the board. Mr. Rees, while remaining on the board, has resigned the position of managing director, which has been taken over by Mr. E. S. W. Moore.

International Light and Power Co.

The directors of this (Canadian) company announce that arrangements have been made to sell the company's interest in the Cia. Luz y Fuerza de Parana and the Parana Tramways Co. for £380,000. It is proposed that a sum of £25,000 shall be paid to J. G. White & Co. as compensation for services rendered, loss of contracts, &c.

Stock Exchange Notices.

The undermentioned have been ordered to be officially quoted:—

British Electric Traction.—£132,626 deferred ordinary stock.

West Midlands Joint Electricity Authority.—£2,000,000 five per cent. stock, 1948-1968, and partly-paid scrip.

Wellman Smith Owen Engineering Corporation.

The accounts for the year ended December 31st last show a loss of £9,135 after providing £3,152 for taxation. The deficit for 1925 was £8,847.

Westminster Electric Supply Corporation, Ltd.

An interim dividend of 8d. per share has been declared on the ordinary capital.

Tyneside Electrical Development Co., Ltd.

Interim dividend of 3 per cent. (less tax) on £1 preferred ordinary shares in respect of the half-year ended July 31st, 1927.

Torquay Tramways Co., Ltd.

An interim dividend of 4 per cent., free of tax, has been declared on the ordinary shares, as in 1926.

Stocks and Shares.

MONDAY EVENING.

STOCK Exchange business is directed more into the markets for industrial stocks and shares than into any of the others. Investment securities keep firm in price, but so far as the purely gilt-edged securities go, public interest is at its usual holiday ebb, and, although quotations remain steady, there is, as the Stock Exchange says, more tone than trade. In the industrial sections, however, activity prevails, and it is that kind of animation which brings rises in its train. A number of the newer scrip stocks are better, County of London Electric 5 per cent., for example, being up to 1¼ premium, while the new Lancashire Electric 5 per cent. debenture has risen to 1¼ premium. Electricity supply shares are almost without movement. Further improvements have occurred amongst foreign traction and lighting issues.

Underground Electric Income Bonds have risen to 103 bid, on the assumption that when the interest payment of £3 net is deducted from the price on September 1st next, this will give the bonds a cheap appearance at 100 ex dividend. While the Stock Exchange takes it for granted that the directors' scheme will be duly passed at the meeting next week, the opponents of the proposals are by no means satisfied, though it seems hardly likely that their objections will carry particular weight. There is some idea, however, that the board, in their obvious anxiety to meet any reasonable criticism, may alter the option price of the shares attached to the bonds from the present proposed 21s., down to 20s. The original scheme provided, it will be recalled, that the bonds should be convertible into shares at 22s. The directors at the last meeting reduced this to a guinea, and they are now being urged to lower it to a pound. The company's £1 shares strengthened to 19s. Other electric railway stocks are quiet, and the market for the steam varieties maintains a sagging disposition.

London's Transport.

The Government has received a scheme, from a sub-committee of the Traffic Advisory Committee, with reference to co-ordination of London's transport service for passengers. There is nothing very novel in the plan, which suggests unified control for tramways, omnibuses, and tubes: pooling of receipts, and the working of separate entities as such, but under joint management. The proposals run upon much the same lines as those which now prevail in the case of the Underground Electric Railways of London, but are wider in their scope and in their application. It seems likely that intelligent anticipation of these recommendations was responsible for the recent inquiries that lifted the prices of a few tramway issues. No further changes have taken place in the London group, but there is a quiet demand for stocks and shares of this description.

Manhattan Electric.

New York's financial vagaries have proved a source of mild disturbance in London, although business between the Stock Exchanges of Throgmorton Street and Wall Street is now on a scale that is negligible as compared with pre-war conditions. New York speculators have been busy with Manhattan Electrics—shares practically unknown on this side, but which rose nearly 80 points during the past few months. For some reason, the Wall Street Stock Exchange Committee ordered an investigation into the stock, and the immediate result was a violent slump in the price, which dropped 60 in one day last week. A firm of Stock Exchange members failed—a very unusual happening in Wall Street—and intense excitement has revolved around Manhattan Electrics every day.

Barcelona Traction Record.

None of the dollar stocks known to London is affected to any noticeable extent. Brazilian Tractions are 2 points better at 173, though the preferred eased off to 143. Barcelona Tractions reached their record high price of 67. Report expects an early increase in the dividend. Amongst other "foreign" issues, Mexican Light and Power preferred is 2 higher at 68¼. Anglo-Argentine second preference have strengthened to 3¼. Perak River 7 per cent. participating debenture is better at 95¼. Kalgoorlie Electric 6 per cent. income debenture stock has gained 3 points at 72½. Of the American-Canadian utilities, Shawinigan Water common is a little lower at 81½. The International Light and Power Company has sold its Panama interests for £350,000 in cash: the company's 5 per cent. first mortgage debentures are quoted at 77½.

Electricity Supply.

London electricity supply shares are steady. Westminster Electrics have recovered the interim dividend of 8d. per share, less tax, taken off the price last week. London Power 5 per cent. debenture stock is quoted at 97. The company has issued an interesting statement of the programme of work which it now has in hand, and which will take several years to complete. Notting Hill preference are ½ higher. Of the provincial shares, Bournemouth and Poole at 58s. are better on the week. The Tyneside Electrical Development Company has declared an interim dividend of 3 per cent., actual, on its preferred ordinary shares. The deferred dividend comes at the end of the year.

Telephones and Cables.

London electricity supply shares are steady. Westminster most of the rise. Canadian Marconis have been a better market, touching 6s. 7½d. before a slight reaction occurred. Marconis rose to 19s. 4½d., to revert to 18s. 9d.: the market in the shares seems to experience a difficulty in getting beyond 19s. United River Plates are better at 10. Chili Telephones, now ex dividend, show a small net fall at 7½. The only change in the cable group is a drop of 10s. in Great Northerns, the recent sharp rise tempting holders to sell.

Strength in Equipment Shares.

Manufacturing issues are generally good. Advances have occurred in British Aluminium, British Insulated, Cromptons and Henleys. Some people have been comparing Siemens, which stand at 25s. 6d., with General Electrics, at 5s. higher. On both shares the dividend, last paid, was 7½ per cent. Siemens give a return of nearly 1 per cent. higher, at current prices, than General Electrics, which yield a trifle under 5 per cent. on the money. It is thought, however, that the G.E.C. will increase its dividend for the current year, while anticipation is not so confident as to the likelihood of an advance in the Siemens dividend. At the meeting of the Enfield Cable Works Company, the chairman spoke cheerily of the prospects, and nobody grumbled at the repetition of the previous dividend rate of 20 per cent., although the company's profits showed a falling-off in consequence of the coal stoppage, and the general strike, in 1926.

Iron and steel shares are moving upwards. The rubber market is also better, and business in rubber shares has revived to a moderate extent. Compared with the prices of a month ago, a number of rubber shares show material gains.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1925.	1926.	Price Aug. 15 1927.	Rise or fall.	Yield. p.c.
	£					
Bournemouth and Poole	1	14	14	58/-xd	+1/-	4 16 7
Brompton Ordinary	1	10	8¾	35/-	—	5 12 6
Charing Cross Ordinary	1	15	8½	25/6xd	—	5 9 10
do. do. 4½ Pref. ...	1	4½	4½	17/6xd	+3d.	5 2 10
Chelsea	1	12	8¾	25/-	—	5 12 0
City of London	1	15	10	28/3	—	4 19 1
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Clyde Valley	1	8	8	30/6	—	5 5 0
County of London	1	15	7½	28/-	—	5 0 0
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Edmundson's Ordinary	1	8	10	33/9	—	5 18 8
do. 7% Pref.	1	6	7	24/6	—	5 14 3
Elec. Supply Corporation	1	10	10	32/-	—	6 5 0
Kensington Ordinary	1	15	8	25/6	—	5 9 10
Lancs. Light and Power	1	7½	7½	26/-	—	5 15 5
London Electric	1	10	8½	24/-	—	5 16 8
do. do. 6% Pref.	5	6	6	5 1/16	—	5 7 10
Metropolitan	1	11	6	29/6xd	—	4 14 11
do. 4½% Pref.	1	4½	4½	17/-	—	5 8 6
Midland Counties	1	5½	6	21/6	—	5 11 7
Newcastle-on-Tyne Ordinary ...	1	7	5	22/-	—	4 10 11
do. 5% Pref. ...	1	5	5	17/6	—	5 14 8
do. 7% Pref. ...	1	7	7	25/-	—	5 12 0
Notting Hill 6% Pref.	10	6	6	10⅝	+⅛	5 15 8
North Met. Elec. 6% Pref.	1	6	6	22/-	—	5 9 1
St. James' and Pall Mall	5	17½	8	25/6	—	5 9 10
South London	1	15	8½	25/-	—	5 13 0
South Metropolitan Pref.	1	7	7	1¼	—	6 8 0
Urban Ordinary	1	7	7	25/-	—	5 12 0
do. 6% Pref.	1	6	6	1 7/8	—	5 13 0
Westminster Ordinary	1	15	8½	25/6xd	+6d.	5 9 10
Whitehall Elec. Invst. 7½% Pref. ...	1	7½	7½	21/-	—	7 2 10
Yorkshire Elec.	1	8	8	30/-	—	5 6 8

HOME RAILS.

Central London Ord. Assented ...	Stock	4	4	71	—	5 12 8
Metropolitan	,,	5	3	54½	—	5 10 2
do. District	,,	8½	8½	64½	—	5 8 6
Underground Electric	£1	Nil	1½	19/-	+6d.	1 11 5
do. do. Income ...	Bonds	6	6	103	+2	*5 16 6

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	108	—	5 16 6
do. Def.	,,	1½	1½	25	—	6 0 0
Automatic Telephone	1	8	10	46/3	—	4 6 6
Chili Telephone	5	5	6	7⅞xd	-⅛	3 18 3
Eastern Extension	10	10	10	18	—	*5 11 1
Eastern Tel. Ord.	Stock	10	10	178½	—	*5 12 1
Globe Tel. and T. Ord.	10	10	10	18½	—	*5 7 5
do. do. Pref.	10	6	6	11	—	5 8 1
Great Northern Tel.	10	20	20	31	-½	6 9 19
Indo-European	25	8½	10	44½	—	*5 7 6
Marconi	1	Nil	Nil	18/9	—	... ...
Marconi-Marine	1	7½	8½	26/3	—	6 13 4
Oriental Telephone Ord.	1	12	12	52/6	—	*4 9 4
United R. Plate Tel.	5	8	8	10	+1/16	*4 0 0
Western Telegraph	10	10	10	17½	—	*5 14 3

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	8½	—	7 17 2
do. do. 2nd Pref. ...	5	6	6	8½	+1/16	8 11 6
do. do. 5% Deb. ...	Stock	5	5	72½	—	6 17 11
British Electric Traction Ord. ...	,,	8	8	119½	—	6 14 0
do. do. 6% Pref. ...	,,	6	8	120½	—	6 12 10
Brazil Traction	100	5	6	173	+2	3 9 4
Brit. Columbia Elec. Rly. Pcs. ...	Stock	5	5	89½	—	5 11 9
do. do. Preferred ...		6¼	6¼	129½	+½	4 16 8
do. do. Deferred	,,	8	8	161	+1	*4 19 5
do. do. Deb.	,,	4¼	4¼	80½	—	5 5 7
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	8/3	—	Nil
London United Tram. Deb. ...	Stock	4	4	63½	—	7 19 5
Mexico Trams, 5% Bonds	—	5	5	74	—4	6 15 2
Mexican Light Common	100	Nil	Nil	39½	+2	Nil
do. Pref.	100	Nil	Nil	68½	+2	Nil
do. 1st Bonds	—	5	5	70½	—	7 1 10
Yorkshire (West Riding)	1	5	—	8/9	—	... ...

MANUFACTURING COMPANIES.

Babcock & Wilcox		13	13	52/6	—	4 19 1
British Aluminium Ord.	1	12½	10	46/9	+1/-	4 5 8
British Elec. Transformer Pref. ...	1	Nil	7	18/3	—	7 18 6
British Insulated Ord.	1	15	15	70/-	+1/8	4 5 9
Brush Ord.	1	10	10	26/3	—	7 12 4
Callenders	1	15	15	8 7/8	—	4 7 4
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	Nil	Nil	16/-	+6d.	... ...
Edison-Swan	4/-	10	10	10/-	—	4 0 0
do. 5% Deb.	Stock	5	5	88	—	5 13 8
Electric Construction	1	10	7½	25/-	—	6 0 0
Enfield Cable Pref.	1	7½	7½	25/-	—	6 0 0
English Electric	1	Nil	Nil	8/-	—9d.	... ...
do. do. Pref.	1	8	—	10/-	—	... ...
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	7½	7½	30/6	—	4 18 4
Henley	1	20	25	95/-	+1/3	5 5 3
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	5	5	18/9	—	*5 6 5
Johnson & Phillips	1	17½	12½	48/9	—	5 2 8
Met.-Vickers Ord.	1	8	8	26/9	—	5 19 8
do. Pref.	2	8	8	2⅜	—	6 14 9
Siemens Ord.	1	7½	7½	25/6	—	5 17 7
Telegraph Construction	12	10	10	97½	—	*4 6 5

* Dividends paid free of Income Tax.

Electrical Imports of Sweden.

THE following figures, showing the values of the imports of electrical and allied goods into Sweden in 1926, are taken from the recently-published official trade returns. For purposes of comparison the figures for 1925 are given and notes of increases or decreases are made.

	1925. Kroner. Thous.	1926. Kroner. Thous.	Inc. or dec. Kroner. Thous.
Accumulators and parts thereof—unmounted cells—			
Total	26	64	+ 38
Germany	26	62	+ 36
Accumulator plates—			
Total	1,364	1,640	+276
Denmark	24	24	—
Germany	1,270	1,551	+281
Great Britain	26	5	− 21
U.S.A.	42	60	+ 18
Cells and batteries, wholly or partly mounted—			
Total	545	833	+288
Denmark	44	35	− 9
Germany	292	480	+188
Great Britain	106	139	+ 33
U.S.A.	94	166	+ 72
Boards for electrical instruments and apparatus, fitted—			
Total	135	100	− 35
Special apparatus for electrical purposes: Röntgen ray apparatus—			
Total	165	164	− 1
Germany	125	136	+ 11
U.S.A.	19	4	− 15
Wireless telegraph and telephone apparatus—			
Total	4,458	4,691	+233
Germany	2,441	2,309	−132
Great Britain	602	614	+ 12
U.S.A.	312	345	+ 33
Other special apparatus for electrical purposes—			
Total	2,643	2,894	+251
Denmark	142	87	− 55
Germany	1,456	1,679	+223
Great Britain	352	665	+313
Switzerland	46	56	+ 10
U.S.A.	233	196	− 37
Galvanic cells—			
Total	1,836	2,516	+680
Denmark	656	1,096	+440
Germany	1,084	1,267	+183
Generators, motors, &c., weighing not more than 500 kilos each—			
Total	1,953	1,800	−153
Denmark	157	110	− 47
Germany	1,226	1,119	−107
Great Britain	81	70	− 11
U.S.A.	334	323	− 11
Ditto, weighing more than 500 but less than 3,000 kilos—			
Total	394	328	− 66
Denmark	163	71	− 92
Germany	115	203	+ 88
Great Britain	46	26	− 20
Ditto, weighing more than 3,000 kilos—			
Total	25	67	+ 42
Denmark	10	—	− 10
Germany	15	67	+ 52
Transformers, 100 to 500 kg.—			
Total	41	29	− 12
Germany	29	27	− 2
U.S.A.	5	—	− 5
Transformers, over 3,000 kg.—			
Total	29	44	+ 15
Germany	18	19	+ 1
Switzerland	11	10	− 1
Metal-filament lamps—			
Total	2,928	2,734	−194
Denmark	48	47	− 1
Germany	1,256	1,311	+ 55
Netherlands	1,419	1,166	−253
Austria	96	72	− 18
Lamp sockets, with and without switches—			
Total	343	299	− 44
Germany	321	279	− 42
Insulating tubes, steel armoured—			
Total (all from Germany)	21	11	− 10
Insulating tubes, other kinds—			
Total	290	257	− 33
Germany	289	253	− 36
Carbon, not specially mentioned, manufactured for electrical purposes, weighing 3 kilos or more—			
Total	1,186	809	−377
Germany	762	454	−308
U.S.A.	245	303	+ 58
Carbon brushes—			
Total	50	74	+ 24
Germany	12	17	+ 5
Great Britain	30	42	+ 12
Carbon: Other kinds			
Total	426	399	− 27
Germany	194	236	+ 42
U.S.A.	187	125	− 62
Starting, regulating, and reduction resistances, controls, and other electric regulators...			
Total	276	326	+ 50
Germany	177	243	+ 66
Bases for incandescent lamps—			
Total	68	53	− 15
Germany	26	11	− 15
Netherlands	42	42	—
Stators, rotors, current collectors, magnet coils, &c., weighing not more than 50 kilos—			
Total	142	341	+199
Denmark	11	8	− 3
Germany	74	258	+184
Current interrupters and reversers, oil brake switches, hand-operated—			
Total	43	52	+ 9
Germany	34	46	+ 12
Box, knife and other switches—			
Total	847	837	− 10
Germany	719	693	− 26
Safety appliances, not specified—			
Total	669	545	−124
Germany	653	526	−127
Electric stoves for household use—			
Total	154	173	+ 19
Denmark	8	4	− 4
Germany	88	119	+ 31
Electricity meters—			
Total	1,187	809	−378
Germany	1,116	721	−395
France	50	48	− 2
Other electrical measuring instruments—			
Total	412	564	+152
U.S.A.	45	47	+ 2
Germany	279	425	+146
Porcelain insulators, conduit pipes, &c.—			
Total	735	690	− 45
Denmark	6	7	+ 1
Germany	681	635	− 46
U.S.A.	23	17	− 6
Electric lighting fittings of brass, coated, varnished and lacquered—			
Total	93	96	+ 3
Germany	73	67	− 6
Cables and cords with sheaths of lead or other metal; maximum diameter 25 mm.—			
Total	537	498	− 39
Denmark	73	43	− 30
Germany	460	443	− 17
Ditto, of greater diameter—			
Total	653	799	+146
Denmark	170	34	−136
Germany	475	751	+276
Ditto, not specified—			
Total	646	635	− 11
Denmark	17	69	+ 52
Germany	479	370	−109
Netherlands	39	54	+ 15
U.S.A.	44	49	+ 5

(£1 = about 17 kr.)

An Electrical Calculating Chart.

A short-cut diagrammatic device for solving power problems for d.c., single- and three-phase a.c.

By D. HORACE JONES MORRISTON.

THE accompanying nomogram will enable one to solve problems of power in a very short time, and the following examples will make the method quite clear :—

Example No. 1.—For a 3-ph., a.c., 440-V circuit, .8 p.f. and .9 efficiency, h.p. =A.V.×1.73×p.f.×Eff./746.
=95×440×1.73×.8×.9/746=69.7 h.p.

Lay a straight edge across points 95 on the 3-ph. amperes line, and on 440 on the 3-ph. volts line; then mark the intersection with line No. 1. Through this point and .9 on efficiency line, mark the intersection on line No. 2. Through this point and .8 on power factor line read off the answer on the h.p. line, and simultaneously read off the kilowatts.

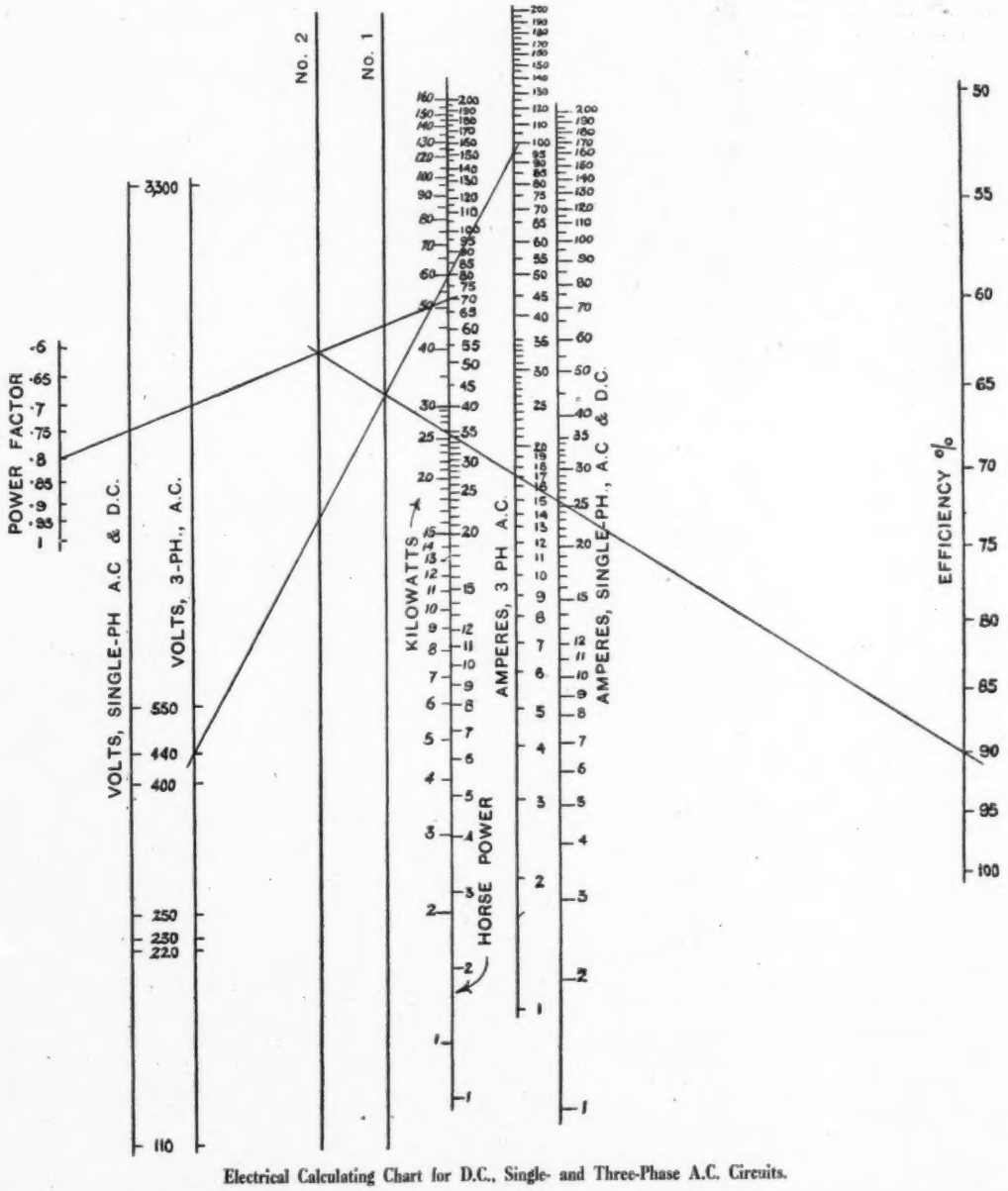
Example No. 2.—For a d.c. 220-V circuit, .8 efficiency;
h.p.=220×25×.8/746=5.9 h.p.

Lay the straight edge on point 25 on the single-phase and d.c. amperes line and point 220 on the single-phase and d.c. volts line. Through the intersection on line No. 1 and .8 on the efficiency line mark the intersection on line No. 2. Through this point and point 1 on the power factor line read off the answer on h.p. line.

Example No. 3.—For a single-phase a.c., 440-V circuit .9 p.f. and .9 efficiency;

h.p.=440×30×.9×.9/176=14.33 h.p.

The above instructions will enable one to follow out the method, taking care to use the proper lines.



Electrical Calculating Chart for D.C., Single- and Three-Phase A.C. Circuits.

The reverse calculations will be found to be quite simple to solve, using No. 2 line first instead of line No. 1. One example will suffice, taking a 3-phase 440-V circuit with a .8 p.f. and .9 efficiency; then 50 h.p.=A×440×1.73×.8×.9/746; amperes=68. Lay the straight edge through 50 on h.p. line and .8 on p.f. line. Through the intersection with line No. 2 and .9 on efficiency line, mark the intersection with line No. 1. Through 440 on the 3-ph., volts line and this latter mark read off the answer in amperes on the 3-ph. amperes line.

Auto-Reclosing Switchgear.

The Motor-operated Truck Type manufactured by Messrs. Ferguson, Pailin, Ltd.

THE electrification of outlying districts is often rendered possible only by the exercise of the strictest economy of capital outlay and in operating cost, unattended sub-stations being consequently frequently built in villages and small towns. Under such conditions an interruption

Fig. 1.—Front View of the 4-panel Truck-type Switchboard.

of the supply of energy, due to the automatic functioning of a circuit breaker, may cause loss of revenue and annoyance to consumers, because the restoration of the service is delayed until an attendant is able to visit the sub-station and reclose the breaker.

In order to simplify the problem by minimising the need for human intervention, Messrs. Ferguson, Pailin, Ltd., have developed a robust automatic reclosing device in conjunction with motor-operated mechanism. The motor-operated type was adopted because in small outlying sub-stations a d.c. supply is not generally available, and the Company has recently shipped some of its well-known interlocked draw-out truck-type switchboards embodying this device to two important Power Boards in New Zealand.

Auto-reclosing Gear.

One of the switchboards shown in fig. 1 comprises four panels, the incoming feeder being non-automatic, whilst the remaining outgoing feeders are each furnished with automatic reclosing features; socket screens automatically shield the live portions on withdrawal of the truck, and the protective features comprise double-pole inverse time-limit overload and instantaneous leakage relays.

The motor closing mechanism consists essentially of four elements—the motor, power reduction gearing, operating-link mechanism, and timed control device. The shaft of the single-phase induction-repulsion type 0.25-h.p. motor carries a pinion, meshing with a spur wheel keyed to a worm shaft through a ball type thrust bearing; a driving disk on each side of the gear box is bolted to the worm wheel and coupled by links to the fixed-handle portion of the standard manual-operating mechanism which houses the trip releases. The fixed-handle portion having been first raised to the "engage" position, as shown in fig. 2, a downward motion closes the breaker. One complete revolution only being required for operation, the motor must start and stop with the operating pin in each driving disk coming to rest in the same place for each operation, which is accomplished by a spring-loaded brake acting as soon as the motor is automatically cut off. The motor circuit is energised from the station lighting transformer and, on closing the control circuit, the motor starts (having sufficient starting torque to overcome the initial brake pressure) and the driving disks, to each of which a cam is fixed, rotate; the left-hand (brake) cam actuates a roller which immediately relieves the tension of two springs, thus releasing the brake pressure. The right-hand (contact timing) cam then closes a contactor (which is in parallel with the timed control switch) and also an auxiliary switch operated from the circuit breaker. The timed control switch and the breaker auxiliary switch now open, leaving the contactor controlling the motor, and the driving disks make one complete revolution, passing through the "engage" position of the operating mechanism, *i.e.*, the circuit breaker being closed, the right-hand cam then allows the contactor to switch off the motor, and simultaneously the left-hand cam allows the brake to function. The auxiliary switch is closed when the circuit breaker is open, but opens before the circuit breaker closes; its function is to ensure that the motor mechanism cannot be started when the circuit breaker is already closed, and the timed control switch eliminates any possibility of the breaker "pumping."

The auto-reclosing attachment is a self-contained device designed to automatically reclose an electrically-operated oil-immersed circuit breaker after it has tripped, due to fault or other conditions, the number of closing operations being adjustable between one and six; there is a definite time interval between each two operations, adjustable between 0.5 and 3 minutes. If, after a predetermined number of closing operations, the breaker once more trips, it will be locked out by a special catch and cannot be reclosed until this catch has been released, either by hand, or by a small remotely-operated solenoid.

Outdoor Sub-stations.

Following on the erection of extension equipment at the main Brimsdown outdoor sub-station of the North Metropolitan Electric Power Co.'s system,* Messrs. Ferguson, Pailin, Ltd., have installed 33-kV outdoor sub-stations at Cuffley, Hertford, Buntingford, and Royston, to the specification of the chief

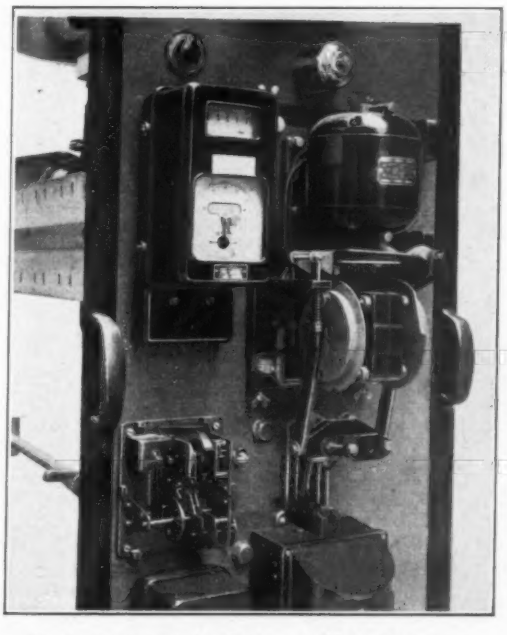


Fig. 2.—Interiors of Auto-Reclose and Motor Mechanisms.

engineer, Capt. J. M. Donaldson, M.C., M.I.E.E. The Cuffley sub-station is fed from Brimsdown and connected by a 0.1-sq. in. feeder to the existing 33-kV radial feeder to Hitchin, at Potter's Bar, thus forming a ring system through Barnet back to Brimsdown. A second 0.1-sq. in. radial feeder commencing at Cuffley feeds in turn Hertford, Buntingford, and Royston, where the feeder is extended to embrace the Shepreth and Sawston outdoor sub-stations of the Bedfordshire, Cambridgeshire and Huntingdonshire Electricity Company, the switchgear for which has also been manufactured by Messrs. Ferguson, Pailin, Ltd.

* See ELEC. REV., October 1st, 1926, p. 527.

The Factories and Workshops Report.

Some of the Observations of H.M. Inspectors during 1926.

(Concluded from page 280.)

Dangerous Trades.

Electric Accumulators.—The number of places to which the Regulations apply tends to increase, particularly in connection with garages, but the inspectors report satisfactory compliance on the whole, great improvements having been effected in certain instances:—

Mr. Shaxby (South Essex).—This industry continues to expand, fortunately in this district it is in the hands of reputable firms which exhibit willingness to fulful all legal requirements and, in fact, to introduce any further improvements that can be suggested to them. The advent of the Regulations has stimulated them to overhaul their arrangements, particularly with regard to application of exhaust draught to the various lead processes. It has caused the expenditure of many hundreds of pounds on ventilating apparatus.

Mr. Verney (South London).—A model installation of exhaust draught, laid down in a small works at great cost in relation to the capital employed in the business, is on the verge of completion.

In one important works where there was an unexpected increase in the number of cases of plumbism, it was found that steps had been taken to increase production and improve the quality of output without giving corresponding attention to the measures necessary to secure health, particularly with regard to the removal of fumes. The matter was taken up with the firm and steps were immediately taken to bring the ventilating installation up to the previous high standard.

As in most lead industries, the chief danger arises from dust, and the application of vacuum cleaners is worthy of note:—

Mr. Barnett (S. Division).—The provision of efficient suction cleaning apparatus at one works has conduced to a much higher standard of cleanliness and freedom from dust on the work benches than hitherto prevailed, and the firm regards it as infinitely superior to the older method of damping down. Since its inauguration the general conditions have materially improved, and the absence of dust in interstices and corners already indicates the efficiency of this system.

Lead Poisoning.—The decline in the reported cases noted in 1925 is continuing. Some of this diminution was undoubtedly due to the adverse conditions of trade, although electric accumulator works, from which 21 fewer cases (total 52, no fatalities) of lead poisoning have been reported, do not appear to have been so seriously affected. It is to be hoped, therefore, that the greater protection afforded by the Code of Regulations, which came into force in March, 1925, may, at any rate to some extent, be responsible for this fall in the number of cases. There is reason to believe that the overtime which had been worked occasionally in the manufacture of electric accumulators contributed to the incidence of lead poisoning in this industry. Overtime is to be discouraged, for each additional hour worked means an increase in the inevitable daily dose of lead dust or other harmful material. There is, however, room for further improvement in the observance of the Regulations affecting this industry, not so much in the mechanical arrangements for exhaust ventilation (though these are by no means perfect in all cases) but in attention to the details of the Regulations which concern cleanliness of floors and benches.

Mercury.—In the repair of electrical meters, two cases of mercurial poisoning, with one fatality, occurred. Examination of some 20 workers in this industry, while not revealing any evidence of mercurial poisoning, demonstrated the possibility of its occurring unless strict attention to cleanliness is observed. The hands of the workers, though apparently free from mercury, when examined by a hand lens showed minute globules of the metal in the creases of the skin and around the nails. Minute globules of metal were also to be seen in the clothing round the neck, so that the importance of wearing overalls extending to and fastening at the neck is demonstrated.

Dermatitis.—In a large municipal tramway works there occurred 16 cases among 132 workers (12 per cent.), the majority among those connected with the preparation and painting of the tramcars, and 15 of them, out of 68 employed (21 per cent.) were affected. With one exception, Dr. Henry found that all those affected had come into contact with "American steam distilled wood turpentine."

Electric Ironing.—Inquiry was made into the condition of the hands of women employed ironing transfers on to stockings. Electric irons were used, and on an average approximately 750 stockings were dealt with per person per day. The process differs from ordinary ironing, as the iron is lifted at each operation, and in some cases a swinging motion is given to the iron. After one day's work well-formed blisters occurred on the skin over the heads of the metacarpal bones, particularly that of the little finger. In six or seven weeks the blisters harden, and at the end of two years there is a horny condition of the skin in the palm of the hand, chiefly along the heads of the metacarpal bones and on the inner aspect of the hand below the little finger. There is some thickening of the skin over the proximal phalanx of the little finger, which appears to involve the flexor tendon, preventing the finger from being completely straightened out. The handles of the irons used are of wood, and in one instance indentations corresponding to the grip were seen. The worker stated definitely that she had not produced these indentations artificially, but they had "come naturally." If this is so, it would appear to indicate considerable pressure and friction. A comparison of the hands of these workers with those of others employed in ordinary ironing, although using heavier irons, showed that there was no material thickening of the skin of the hands of the latter, even after many years' employment.

Labour-Saving Appliances.

In Chapter III Mr. W. F. Findlay states that throughout the country during the last few years there has been a considerable increase in the use of appliances for reducing labour. The increase, nevertheless, has not been quite so great as the evident utility of such appliances would have led one to expect; few entirely new kinds of labour-saving devices have been developed, but the designs of those in use have been improved and their application extended.

Cranes.—A device in use at Manchester docks consists of a portable control for electric cranes. The crane driver, instead of standing on the crane platform, takes his place on the deck of the ship, and has a portable controller attached to his shoulders by means of straps, and to the crane by cable. From his moving positions on deck he can see into the hold and has also a clear view of the deck and shore. This device gives the crane driver complete control over his crane, and greatly increases its efficiency.

Trucks.—Reports from different parts of the country refer to the growing use of self-propelled railless trucks. They generally get their power from electric accumulators, and are driven by a man who stands on a small platform either at the front or back of the truck.

Charging Machines.—Recent developments in the iron and steel trades have done away with the necessity for much heavy labour. One of the most outstanding of these has been the installation of electrically-driven charging appliances at blast furnaces. In a plant of this kind at present under construction an electric car travels in front of hoppers containing ore, coke and limestone, and receives from each the quantity of material required. The car then runs to the base of the furnace and drops its contents into a skip. The skip is drawn up an inclined plane to the top of the furnace, and on reaching there tips its contents over the bell. On the bell opening the material drops into the furnace. One man standing at the base of the furnace controls all the above operations. Very similar is a discharging machine which has a ram instead of a scoop, and is used for pushing coke out of horizontal retorts open at the back.

Floor Scrubber.—An appliance which aids cleanliness is an electric floor scrubber, consisting of a motor-driven disk on a vertical spindle, the underside of the disk being studded with a number of stiff brushes which are fed with soap solution from a tank above. The machine is mounted on castors and as it is connected to the power supply by a flexible cable, can be moved about a room like an ordinary domestic vacuum cleaner. The machine reported on was seen in a sugar confectionery works, and though it is well known that such works are difficult to keep clean, the floors of that particular factory were in a spotless condition.

Lighting.

The numerous references to this subject make it clear that a great deal of systematic attention has been given to adequate lighting, both natural and artificial, and that most manufacturers now realise that if output and good workmanship are to be maintained lighting must be adequate in amount and suitable for the particular work in hand.

Mr. Werner (Midland Division) mentions that much good work has been done in Coventry, where occupiers and managers have experimented with two different systems:—(1) individual lamps for each machine, (2) powerful lamps, suitably shaded, fixed high up. The latter system is, he states, generally preferred in saw mills, aeroplane and motor engine shops, and in most large open shops, if there is not too much overhead mill gearing. Many managers, however, prefer a separate lamp for each machine, and on this point Mr. Rogers (Coventry) continues:—The processes for which these individual lamps seem to be favoured include machine engraving, power press work, spoke heading and swaging, small electrical work (especially in connection with magneto, radio and telephone making) and watch jewel making. The use of bench

coverings, which are of such a colour and texture as to prevent reflection of bright light into the eyes of the workers, has now become established in factories in which small electrical work is carried on, and the provision of shades of suitable design and colour has become much more common.

Mr. C. H. Taylor (Shrewsbury) mentions that in one works where safes are made, and in view of the fine work to be done on safe locks, a bench level illumination of 10 foot-candles is aimed at. Artificial "daylight" is being more widely used in the colour-mixing rooms of some of the worsted spinning mills in Halifax and in a few cases is used at all times. Similar installations are described by the Newport and Wrexham inspectors for enabling the exact colours of samples and of materials in process of manufacture to be correctly gauged, a task difficult to accomplish with other means of artificial lighting. Some good instances are quoted to illustrate the evil effects of glare.

Mr. Clark (Finsbury).—In several factories deeply shaded electric lamps have been adopted, so arranged as to provide a high standard of illumination on the work benches and a lower standard in the alleyways where the high standard is not necessary. This has proved to be successful, but in one factory the workers raised considerable objections at first on account of the gloomy aspect of the workroom, as compared with former conditions. These objections, however, appear to have gradually lessened with continual use. One large firm of printers stated that three results had been obtained from the change, *viz.* (1) better illumination on the work, (2) absence of glare, (3) economy in lighting cost.

Mr. Turner (Reading).—In one printing works where there are a considerable number of bag machines, the management had several complaints from the men who were employed during the night shift that they suffered from head-ache and eye-strain. It is necessary to light these machines very well, and gasfilled electric lamps were used with ordinary conical shades, the lamps being approximately at head height. The workers rigged up various paper shades to try and avoid the direct rays of the lamp, but without very much success because, if efficient in this respect, parts of the machine were not properly lighted. Consequently special lamps were installed, having a small narrow cylinder of white reflecting material surrounding the bulb of the lamp, but some little distance from it. This cylinder is supported from the reflector by three pins, the length of which can be varied, moving the cylinder vertically. The cylinder is adjusted so that it comes between the worker's eye and the filament.

Miss Ewart (Leeds North).—In one factory the old type shallow shade had been extended by a 3½-in. band of enamelled sheet metal. In another factory each machine was fitted with a 20-candle power needle light, general lighting being effected by 75-100 watt lamps with "Benjamin" shades. The manager stated that, as the needle lights were controlled by each worker, there had followed an increased efficiency in the work and the initial outlay had proved a definite economy. On the lithographing machines in a printing works, the men suffered from reflected glare from the yellow paper. As an experiment blue tinted lamps were substituted for the ordinary clear-glass type previously in use and the men stated they now had no feeling of eye strain.

Mr. Phillips (Liverpool).—In a clothing factory, where about 400 persons are employed, a new system of lighting has been recently introduced; the general lighting is provided by means of 60-c.p. "Benjamin" electric lamps placed 11 ft. above the floor and spaced 9 ft. apart in a longitudinal direction and 8 ft. in a transverse direction. In addition, each sewing machine is provided with a 6-c.p. electric lamp fixed at the head of the machine to direct the light on to the work in the machine; these small lights are contained in metal shades of green colour so that the source of light is outside the line of the workers' vision.

Mr. le Couteur (Divisional Inspector, North-Western Division).—An example of modern semi-direct lighting exists in a weaving shed in Leigh. The lamps used are 500-watt gas-filled, each giving 1,000 c.p.; they are fixed at about 12 ft. 6 in. from the floor. Above each lamp is a reflector 2 ft. in diameter, and the whole is enclosed in an opaque (*sic*) glass globe; the lamp may be looked at directly without occasioning any sense of eye-strain. The shed has an area of some 57,000 square feet, and contains 750 looms; to light this 253 lamps are used, these being equally spaced throughout the shed. The result is a pleasant, singularly effective and absolutely shadowless illumination; the work consists almost wholly of coloured goods, and the management considers the expense of running this lighting system is justified; its efficiency is very much enhanced by the fact that each loom has its own motor drive, the motor being adjacent to the loom, and in consequence there is no overhead transmission machinery whatever; in fact, conditions in this mill are, as a whole, very much above the average.

Mr. Brown (Scotland) remarks that the lighting of foundries requires special consideration in view of the fact that the maximum illumination is required at the floor level, and, further, on account of the black floors, there is a maximum amount of light absorption and no reflection from other sources. Several occupiers have recognised this and he quotes the case of a large firm of rubber manufacturers which, by rearrangement of the lighting system in several departments, increased the output by amounts varying from 7 to 16 per cent.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A Heavy-Duty Fuse.

We have received from the CASTLE FUSE & ENGINEERING CO., LTD., 33, Chester Street, Liverpool, a sample of its recent production, the "Triumph" fuse, fig. 1. It is a 60-A device with a bridge-fuse handle, and of unusual design.

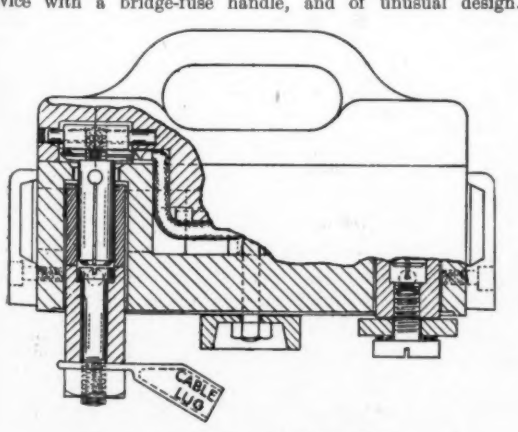


Fig. 1.—Construction of "Triumph" Fuse.

Heavy pin-type plugs are screwed into metal pieces held loosely in the porcelain of the handle, the fuse eyelet terminals being clamped between the metal pieces and collars provided on the pins. The fuse wire is taken round a projecting piece of the handle which enters a well-protected explosion chamber in the base. Four ducts run from this chamber to the ends of the base, two at each end, to take away the combustion gases. Pieces of copper gauze span the ends between the ducts, the ends of the gauze being turned into the ducts. Presumably this is to prevent the escape of the flame and to conduct the heat from the fuse compartment. Porcelain protecting pieces are screwed to each end of the base to cover the ducts and gauze, suitable ventilation space being provided. Suitable sockets in the base accommodate the plugs, and are held in position by means of screws inserted in convenient holes in the sides of the porcelain. Direct connection to the sockets is arranged for at the back. One socket is projected beyond the porcelain and drilled to take the conductor direct, a clamping screw being provided internally from the front of the socket. The other socket provides for external connection by means of an eye terminal. It is claimed that the contacts will carry continuously 240 A with a temperature rise of only 40 deg. F. Switchboard fixing is arranged for by means of two bolts in suitable holes through the porcelain. All the surfaces of the porcelain likely to be subjected to heat from the metal parts are well covered with asbestos. A stock sample 60-A "Triumph" fuse was recently tested with a short-circuit load of 3,000 kW at 300 V with various sizes of tinned-copper fuse wire. In every case the fuse "cleared," it is claimed, the short-circuit perfectly without damage to itself and with very slight emission of gases.

An Exposed-Element Cooker.

A recent introduction of MESSRS. ELECTRICAL UTILITIES, LTD., Tudor Works, Park Royal, London, N.W.10, is the 2-kW "Heetrod" cooker, fig. 2. It is equipped with four 500-W solid silicon-composition resistance elements, which, it is claimed, can be run at a bright red heat without danger

of deterioration or other faults developing. The rods themselves look like black unglazed porcelain, and are clipped in strong pressure clips. The ends of the elements are specially treated to reduce the resistance at those parts, so that the ends remain comparatively cool, whilst the centre runs at 1,700 deg. F. "Heetrod" elements have peculiar characteristics which render them particularly suitable, it is claimed, for use in "exposed-element" cooking utensils, inasmuch as the spilling of liquids or even the "short-circuiting" of two

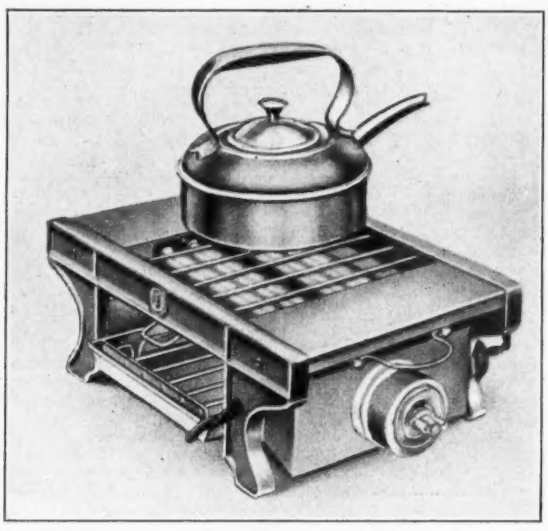


Fig. 2.—Two kW "Heetrod" Cooker.

elements will have no deleterious effect on the resistance. Should, however, an element have to be renewed, say, in the case of mechanical breakage, and the like, it is a matter of three minutes' work to take it out and replace it with a new one, no screwdrivers or other tools being wanted. The cooker is fitted with a 3-heat and "off" position switch. A 1-kW model of this cooker is also made, but is not provided with multiple-heat control.

A Limit Control Switch.

The extensive use of automatic control for the operation of skip hoists, transporters, and other classes of material handling plant has led the Dalyte Electrical Co., Deco Engineering Works, West Row, North Kensington, London, W.10, to evolve a switch to meet the special requirements of such apparatus. It is designed particularly for use in starting, accelerating, slowing and stopping any type of plant where auto-contactors are employed. The switch is of simple and

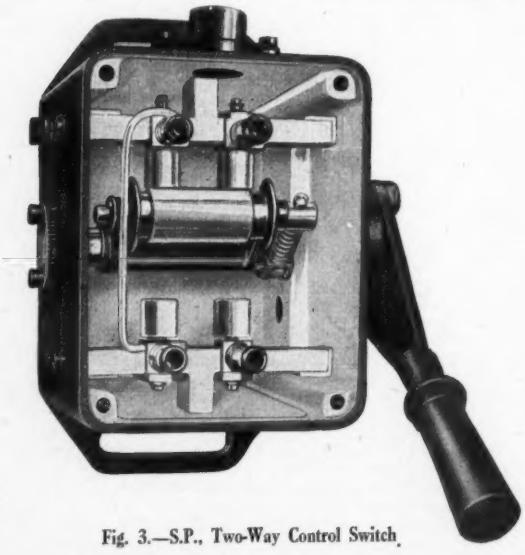


Fig. 3.—S.P., Two-Way Control Switch.

robust construction, with a positive quick make-and-break. It is supplied in one-way and change-over types, single-, double- and triple-pole, and can be fitted with shunt trip-delay action or other combinations to meet special requirements. A variety of operating levers may be adopted for use with the universal hub provided, and a standard range of cable fittings are also listed by the company. Fig. 3 shows a single-pole two-way model with the cover removed. The movements are enclosed in a substantial cast-iron box fitted with a dust- and weather-proof cover. The contact studs are of solid copper of ample cross section; they are spring controlled to assist the make and break, and each pair is mounted on a special moulded insulating bridge, fitted with a "tee" back support, which also carries "easy-wire" terminals of the spring-control plunger type. The moving contact is of the self-aligning roller type and is carried from a pivoted support on the main operating spindle and controlled by means of a strong, but particularly effective, simple mechanism of the compression-spring type. The external operating lever moves through 60 deg., but only 35 deg. are required for the actual operation, so that after the switch is moved in either direction it can traverse a further 12.5 deg. A ¾-in. conduit nipple is fitted as a standard to all switches, and watertight and armoured-cable glands and sealing boxes can be supplied if required. The apparatus is standardised in four capacities up to 25 A and 650 V. An earthing screw is provided for each switch.

A Colliery Winding Indicator.

A somewhat novel type of colliery winding signal indicator has recently been designed and manufactured to the order of Sutton Manor Colliery, Lancashire, by Messrs. Automatic Telephone Manufacturing Co., Ltd., Strowger Works, Liverpool. The standard pattern of A.T.M. winding signal indicator is designed for use in surface-winding engine rooms and does not entail any special precautions against sparking or electrical ignition in gaseous atmospheres as is the case with underground equipment. At Sutton Manor an intermediate winding level below the surface rendered it necessary for a flame-proof

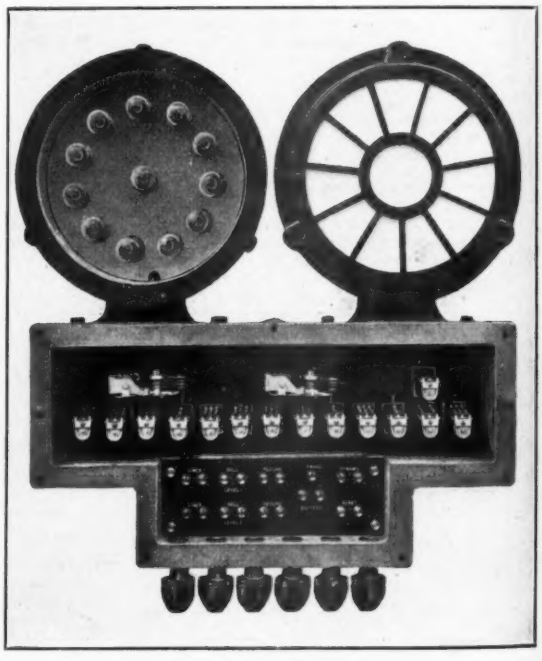


Fig. 4.—Flame-Proof Winding Indicator.

construction of the indicator. In its general principles the flame-proof apparatus follows the standard practice as applied to the surface type, but differs in the arrangement and disposition of the luminous panels, and the relay and switch mechanisms. Fig. 4 shows the device with one of the panel covers and the mechanism cover removed. The panels are arranged as sectors, surrounding a central circular panel, webs at the back of the removable glazed dial serving to divide the body of the casing into light-tight compartments. The two circular centre panels indicate the origin of the signals "Top" and "Bottom" respectively, whilst the statutory signals, "Raise," "Stop," "Lower Steadily," "MEN 3," &c., are arranged clockwise in the surrounding sectors, leaving five extra panels available for local signals at the disposal of the colliery manager. The switch mechanisms and relays are housed in the compartment below the dials, six lead-in cable glands serving for the necessary shaft cables. The operating pressure for the indicator is 12 V; 12-c.p. lamps are employed and fed directly from the colliery lighting mains through a small static step-down transformer. A small 12-V accumulator supplies the relays, switch mechanism and bells. The dial fronts and cover of the relay compartment are secured by special bolts requiring a key to release them. A separate flame-proof cast-iron box fixed in a convenient position near the winding-engine man houses three keys; one to reset the indicator, and the others for recording the last signal sent on either dial after cancellation. The "MEN 3" signal remains displayed until the end of a wind and cancels only when the engine comes to rest, or may even prevail during the succeeding wind should the cautionary signal be repeated while winding is in progress.

Fabricated Electrical Machinery.

A brief account of a manufacturing process which almost eliminates castings hitherto used in machine construction in favour of rolled steel, gas-flame cut, and readily fabricated by metallic arc welding: resulting in greater freedom of design, quicker production, and stronger and superior final products.

A FUNDAMENTAL innovation has been introduced into the manufacturing methods of the General Electric Co. of America.* It has adopted a new and better process, the full application of which has yet to be realised, but it has already attained to surprising proportions. Briefly, most of the iron and steel castings formerly used in the construction of electrical apparatus are being superseded by rolled steel-mill products, fabricated to shape with the aid of the gas-flame cutting torch and metallic welding arc.

The confidence placed in the new process appears to have been convincingly evident to visitors to the company's factories. The designer has found new freedom, for he need no longer strive to fit his design to existing patterns, and he can regard new shapes and dimensions, in respect of time and cost, merely as new drawings. Large electrical machinery is usually "custom-made," *i.e.*, its design has to be varied to comply with customers' requirements, which frequently demand such alterations as to necessitate new patterns. By the G.E. Co.'s new process large stator frames are declared to have actually been made in less time than would have been necessary to produce the new patterns. Consequently overhead charges and shop space can be reduced: moreover, steel-mill material can be rolled to shape close to finished dimensions, thus reducing the amount of machining needed; also, its more uniform characteristics imparted by successive hot working permit of it being more readily machined, and (weight for weight) it is stronger than castings.

The furnaces in which the slabs are heated and "soaked" take 30-ft. lengths and 46-in. widths. The heaviest sections rolled seldom exceed 8¼ in. by 40 in.; frames as small as 11½ in. inside diameter have been rolled from 1¼-in. by 13-in. material. Armature spiders of large low-speed steel-mill direct-current motors and small high-speed motors are also fabricated by much the same methods. A stator frame 40 ft. in diameter and 6 ft. high for a waterwheel-driven generator contains 2,000 ft. of weld.

Fabrication of bases by the arc-welding of standard structural shapes saves time and expense, and circular bases for vertical machines are usually formed by welding top and bottom rings to a deep steel-plate hoop; bearing pedestals as large as those required for a 4,000-kW machine have been fabricated from plates. In fact, whenever a standard structural shape of the required size or character is not available, it can be fabricated with little trouble from plates or slabs. Not only is it possible to build units of great capacity without castings, but also without the aid of proportionately large machine tools. Fabrication begins with the flame cutting of plates and slabs from 3/16 to 8 in. thick, fair and smooth to a limit of 1/32 in. over or under. Semi-automatic machines hold the torches and impart longitudinal, lateral, or circular motions, or combinations of them, and a comparatively recent improvement is the use of illuminating gas instead of the much more expensive acetylene or hydrogen commonly used as the fuel gas with the cutting oxygen; 0.5-in. plates are cut at the rate of 15 in. per minute; 1-in.

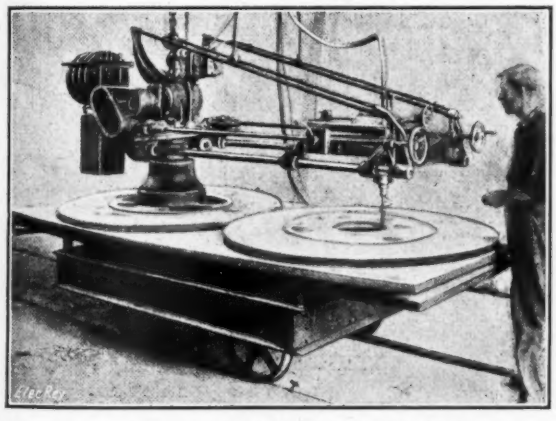


Fig. 1.—Automatic Gas-flame Cutting Machine.

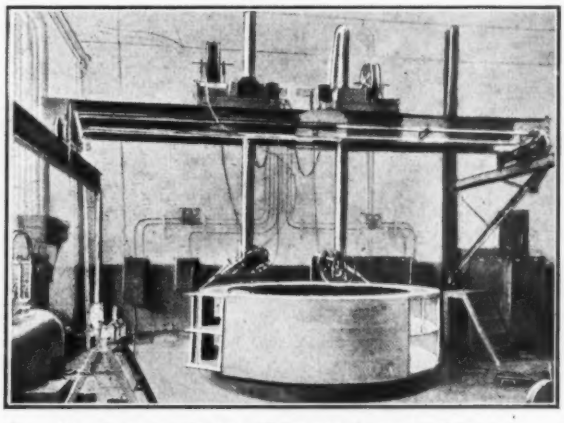


Fig. 2.—Automatic Arc-welder for Large Stator Frames.

The production of castings requires the maintenance of pattern shops, pattern storage, core shops and ovens, and foundries, together with space and equipment for preparing castings for the machine shop. Casting losses are inevitable and indeterminate; defects may not be noted until much labour and many machine-tool hours have been spent upon them; gross weight is greatly in excess of finished weight because of the requirements of the moulder's art in respect of draft, risers, gates, and pattern rapping.

Not alone for its mechanical features has the designer resorted to fabricated construction. The same density of field flux can be produced with less exciting copper when the magnetic paths are through rolled steel instead of castings. The characteristic sections, the lighter forms, and the simplicity with which openings can be provided without weakening a structure make for greater freedom of ventilation, and hence make possible more output from a given displacement, or equal output from a more compact design. In cases of internal loads resulting from frequent and rapid acceleration and from dynamic braking being of considerable magnitude (*i.e.*, motors for elevators, mine hoists, reversing mills, &c.) fabricated construction throughout results in smaller revolving weights and smaller diameters; this reduction of flywheel effect enables the motor, within its limit of heating, to carry heavier load, or operate on a faster cycle.

Magnet frames are now made by hot rolling steel slabs to the desired radius; frames that need not be split are rolled from one piece and the ends welded together; split frames are rolled in semi-circles, and feet slabs are welded to the frame, while pre-machined round bosses cut from billets are welded on to split frames to hold the halves together.

plates at 10½ in.; 2-in. plates at 7½ in. The edges are not burned down by the cutting process, and the cut surfaces are comparable with those made by a fine sharp saw in hard wood. Figs. 1 and 2, reproduced from the *American Machinist*, illustrate the machines employed.

Parts thus cut match perfectly for welding, exposed edges require only painting, and machining is confined to those parts requiring machine fits. Unlike machine cutting, the plate does not have to be clamped down, and much time is thus saved in addition to that credited to the rapid cutting of the flame, as compared with any form of tool. The welding is done largely by machines which automatically feed the electrode from a reel to the arc and form the weld at a faster rate than can be attained by hand; hand welding is done around fittings and on short seams in general.

The manufacturing process outlined evidently heralds a new era in machine construction. The cost of welded frames is said to be cheaper than that of cast frames, and the general average weight reduction claimed is about one-third, the effect of which on shipping and installation facilities in the case of large-capacity machines is apparent. Three 50,000-kVA, 3-phase, 50-cycle, 13,200-volt, 600-r.p.m. synchronous condensers are now nearing completion for the Southern California Edison Co. These machines, which have been fabricated in the manner described, are said to be the largest of their kind ever built, and they will be used to regulate the voltage of a 220,000-volt transmission line.

Plant fabrication, in conjunction with advances in the technique of electric welding,† is evidently an outstanding development of economic importance.

* From the *General Electric Review*, July, 1927.

† See "Arc Welding Aided by Hydrogen," Electrical Review, January 7th, 1927.

Coal Purchase.

The Buying and Selling of Industrial Fuel on a Calorific-Value Basis.

By A. H. TISSINGTON (Fine Cotton Spinners' and Doublers' Association, Ltd.).

Abstract of an article published in the Fuel Economy Review.

WE have for a long time recognised the importance of buying our fuel on calorific lines, but it was not until the year 1923 that we could prevail upon any firm to sell it to us on this basis. Since that year we have been steadily making progress, and we now claim to have passed out of the experimental stage.

Some collieries which last year were averse to selling their fuel on a calorific standard have this year indicated their willingness to do so, as a result, perhaps, of the prominence that was given to this method of buying and selling in the evidence contained in the Report of the Royal Commission on the Coal Industry, 1925.

If collieries are willing to sell on a calorific standard, surely buyers ought not to be backward in taking advantage of the improved method for buying. In a great many cases buyers will not go to the trouble of sampling in a scientific manner the fuel they receive, in order to buy it on calorific lines. To do so, however, is not only in the interest of the buyer, but also of the seller, for to the latter it offers great encouragement to supply fuel rather better than the agreed standard, thus obtaining a slightly higher price for it in the form of a bonus, as prescribed in a special contract which is drawn up. Another great advantage that we have gained in purchasing fuel in this scientific way is that more mutual confidence has been engendered between the seller and buyer than previously existed.

In times past a colliery or merchant had an idea that we were trying to get a financial advantage by suggesting the buying of coal in this way, but all that has now passed away. It is perhaps right to state that all our analytical work is carried out entirely by an independent firm.

We invite the collieries to analyse the fuel for themselves and to compare the results with ours, but in quite a number of cases the sellers are willing to accept our figures as a standard.

In the matter of buying and selling coal on a calorific value basis, the fixing of a fair standard is one that is mutually arranged between the buyer and the seller, and is not done in any arbitrary way by ourselves, but is, and should be, a subject of mutual understanding.

Our practice when trying a new fuel is to burn it, say, for a month, and during that time to take samples from each delivery. These samples are thrown into an air-tight galvanised-iron box, and at the end of each week the box is emptied and samples drawn in accordance with instructions contained in the contract. The sampling is continued for a month, when we ascertain if there is any wide disparity between one week's result and another. If there is none, we suggest that the average of the four results should be the standard. Sometimes we find that the seller also has analysed the fuel, and that in a great measure his results coincide with ours. We have never yet failed to come to a mutually satisfactory agreement. If a mutual agreement could not be arrived at after a short time, we should revert to the old method of buying, though up to now we have not had occasion to do this.

The greatest objection that has been levelled by critics against the scheme of buying on calorific lines is the matter of sampling. It is argued that samples can be drawn in any way to make any result. In this we agree, but if samples are taken in the way we prescribe in the contract, the results generally average fairly near to the standard. The conditions agreed for 1926 were:—Moisture content, 4.0 per cent.; ash content, 8.5 per cent.; and calorific value, 13,000 B.th.u. The actual deliveries for the first four months of the year varied from 2.15 per cent. to 6.84 per cent. for moisture content, from 4.7 per cent. to 10.10 per cent. for ash content, and from 12,900 to 13,500 B.th.u. for calorific value.

No penalties or bonuses were involved during the period mentioned.

Our general experience has been that there might be a small sum to be paid by way of bonus to the supplier one month, and occasionally a small sum is exacted by way of penalty during another month; but, on the average the figures in most cases prove to have averaged themselves satisfactorily to both parties.

Naturally, as we get an advantage when the fuel improves upon the standard, we welcome the payment of a bonus, as we get correspondingly good results in our consumption. We are also strongly of the opinion that the knowledge of the fact that our fuel is tested ensures special attention being given by the supplier to all our consignments, and accordingly the standard of the fuel we receive is now incomparably superior to that which we had before the calorific question entered into our contract negotiations.

This fact is one of the most important features and one of the strongest arguments in favour of purchasing on a scientific basis.

In 1925 the quality of a Lancashire dry slack fell away from the mutually agreed standard immediately the contract operated, and, with one or two exceptions, when a bonus was paid, penalties were exacted almost every month. Had this contract not operated on calorific lines, we should hardly have had any redress when the poor quality of the fuel was discovered, and the case under notice serves to illustrate that we only paid for the value we actually obtained. A few instances recorded are sufficient to demonstrate that the fuels showing a consistently good record are those which a buyer would naturally seek in the market, and test at other mills where the analyses were not so favourable. It will, of course, be appreciated that there are occasions when a slack with a medium calorific value will give better results on certain types of furnaces than fuel of a higher calorific value. This, of course, is brought about by varying local conditions, but, generally speaking, the higher the calorific value and the lower the moisture and ash content, the better is the fuel for our purpose. For the current year we have forty-six contracts on calorific lines, out of about sixty-six contracts in all. The twenty contracts not on a calorific-value basis are, in many cases, comparatively small ones, though in due course we are hopeful that the whole of our contracts will be placed on what we believe to be the only proper basis for dealing with coal supplies.

Colliery owners sometimes argue that they are not anxious to sell on calorific-value lines because the coal varies so much, that it is not a manufactured article, that the quality fluctuates in the various seams they raise, and, therefore, they have no control over it. In so arguing they put the strongest case into the buyer's hands for purchasing coal on the lines suggested. Why should a buyer pay a stipulated price for fuel that varies in quality ? If a seller delivers something above the standard arranged and contracted for, surely he is entitled to extra payment. On the other hand, if his quality falls below what he contracts for, the buyer can hardly be expected to pay the same price—yet this is what is happening day after day.

With regard to the argument that it is impossible for a contract to be performed satisfactorily on a calorific-value basis, our experience, so far, has been that it is not only possible, but highly satisfactory, and that it is a method that can be still further developed to the great advantage and help of all large buyers and sellers of coal, and we are looking forward to the time when this method will be as extensively taken advantage of in this country as it is now in America.

Wood Preservation.

Preservatives against decay are injected into wooden poles with an apparatus like a hypodermic needle on a large scale by a recently patented German process. Rows of holes are made all around the pole in the zone liable to rotting, and appropriate chemicals in paste form are forced into them through tubes. The preservatives then spread along the grain of the wood, the area around each injection overlapping those around its neighbours and forming a complete protective sheath. The inventor claims several advantages for his process. Inasmuch as the apparatus is compact and easily portable, poles can be treated where they are to be set, instead of having to be assembled at permanently located treating tanks and then shipped out again. One or two men can do all the work, instead of the larger gangs now needed. Untreated posts already erected can be treated without pulling them up and resetting them. A saving in material is also claimed. The creosoting processes now used treat either the whole pole, or at least the whole underground part of it, to the same depth. This is said to be unnecessary, because the maximum decay takes place at the ground level and for a couple of feet below it, the butt of the pole usually rotting little more than the top. By the new process it is possible to give the rapidly decaying zone a heavy dose of the preservative, and then give the rest of the pole a lighter treatment.—*Science Service.*

Reviews.

Electric Wiring Diagrams for Motor Vehicles. By MORTIMER A. CODD. 3rd Edition. Pp. iv+241; 241 diagrams. London: E. & F. N. Spon, Ltd. Price, 4s. 6d. net.

This work is a collection of diagrams of lighting and ignition circuits used on the leading makes of British, European and American cars. In some cases theoretical diagrams are also given, enabling the various circuits to be readily traced. It would be a great advantage if all systems were similarly treated, as many of them are distinctly difficult to follow, unless one is well acquainted with the switch connections. The wiring, however, is very clearly shown and the colours of the coverings are indicated. The book should be invaluable at garages and motor schools for ready reference, also for anyone studying the different systems. The index covers the types of cars and the systems referred to.

Abridged Wiring Regulations (May, 1927). Pp. 72. London: The Electrical Contractors' Association (Incorp.). Price 1s. 6d.

This follows so closely on the heels of the very similar publication of the A.S.E.E., which we reviewed last week, that comparisons, however "odious" to either, are almost inevitable. The E.C.A. booklet, according to its sub-title, consists of "extracts selected . . . from the Ninth Edition of the I.E.E. Regulations . . . together with explanatory notes by the Association," and is intended "for the use of wiring contractors" and their wiremen. Apart from its notes, it aims at nothing more than an abridgement of the official code by a simple process of selection from the regulations "which more directly concern the business of installation wiring"; and no attempt is made to condense or simplify the original phrasing of the selected clauses.

That is a pity. An abridgement attained by skilful summary or paraphrase could have been made not only shorter and clearer, but of definite value, if only as an example to the framers of the next edition of the I.E.E. Regulations, whereas a mere verbatim reprinting of what must necessarily be a large proportion of the full code is no more than any user of it could contrive for himself in half an hour with the aid of a blue pencil. A single example of "editing" as against the "scissors-and-paste" method will illustrate the point. The A.S.E.E. *Guide*—which does make some slight attempt to provide alternative wording—is able to condense into one short paragraph (5) the three definitions of "pressure" (8-10) which the E.C.A. *Abridgement* reprints in full.

Within the modest limits it has set itself, the E.C.A. has produced a useful handbook. An excellent feature is the use of varying types, their own annotations being easily distinguished by large italics. (It is curious that the medium type used for the definitions on the first two pages is not used elsewhere, as it well might have been, for clauses of no more importance.) Another good feature is that the heading of every omitted clause is given in its numerical order, facilitating reference when necessary to the I.E.E. book. A comparatively large selection of the I.E.E. tables is given, but one or two of them might well have been omitted in favour of an index.

The regulations and sub-sections omitted are those dealing with private plants and those concerning principally manufacturers and supply engineers; and the selection is, naturally enough, very similar to that made by the A.S.E.E.—though there are some curious discrepancies, which space will not allow us to analyse. Regulations (67-69) and (94), for instance, which we alluded to in our review of the A.S.E.E. *Guide*, are treated in the *Abridgement* on entirely different and somewhat better lines; and of the 33 definitions between (11) and (43) the two compilers only agree on 8, and disagree on 17 others which between them they include. *Quot homines, tot sententiæ.* Probably a third selector would differ from both; which may be taken as a tribute to—or a reflection on—the original I.E.E. compilation.

The E.C.A. explanatory notes—there are, regrettably, no diagrams—are, of course, the most interesting feature of the handbook; and where they occur they are very full—indeed, in some cases, almost too full. The notes to the various sections quoted from (68) occupy about two pages, mostly tending to repetition of themselves and the text; and they are largely made superfluous by the useful table on p. 6, which summarises the preceding wording. Moreover, some of this is again repeated in the long but otherwise admirable note to (95). There is another very long note under (96, 97), some of which is rather obvious in the light of the text, and the rest of which might easily have been condensed.

The chief value of such handbooks as these of the E.C.A. and the A.S.E.E. lies in their original matter—diagrams and notes—intended to clear up ambiguities in the Regulations and to illustrate possible applications of them. But notes that are too long, are framed in sentences of over 120 words—see note to (112)—and, incidentally, refer to clauses not quoted in the abridgement, are liable to be quite as confusing as the text they set out to elucidate.

Despite these minor blemishes, almost to be expected in a first and experimental edition, the E.C.A. *Abridgement* will be found by those for whom it is intended a definite improvement on the official publication. It is welcome, too, as emphasising the demand of the practical man for a short and simple code of wiring rules. If the Wiring Rules Committee can only be persuaded to give ear to it, we may perhaps be given in the Tenth Edition something so clear and concise and completely to the purpose, that future issues of the E.C.A. handbook will have to change the adjective in the title from "abridged" to "amplified"! H.R.T.

Correspondence.

***Correspondents should forward their communications as early as possible.** No letter can be published unless we have the writer's name and address in our possession.*

"The Employees' Guide."

We have read with considerable interest and appreciation the review of the above handbook by "H.R.T.," published in the ELECTRICAL REVIEW of August 12th, but we would point out that "The Employees' Guide" was compiled from the employees' point of view, which accounts for the inclusion of Clause C of I.E.E. Regulation 60. This clause is a matter for the employee on the job, but clauses B, D, and E are matters for the contractor or manufacturer, and for that reason were omitted.

With regard to I.E.E. Regulation 67, clause J, this again is information for the man on the job, but clause G is entirely new matter, not in the Eighth Edition, and was thought useful to include in the extracts for "The Guide."

We naturally omitted clauses H and L as they deal largely with construction or manufacturing.

"H.R.T.'s" criticism regarding Regulation 87 is, we think, somewhat unfair and contradictory. He rather grudgingly admits that the multi-repetition of sub-clauses makes for clarity, but complains because this most important section occupies 15 pages of "The Guide"; he also makes a vague suggestion of a "simple tabulation of the confusing book references of the I.E.E. original." May we suggest that such criticism is destructive and not constructive, unless the suggestion is put into concrete form and the result is one that will likewise increase clarity to "the practical user of it seeking simplicity." Back references, to say the least, are irritating, which "The Employees' Guide" has gone a long way to overcome.

We included Clause A of Regulation 94 in "The Guide" because it was considered to embrace sufficient general information, while the remaining clauses were excluded because they dealt mainly with constructional details or points more nearly concerning the contractor than the employee.

The Reviewer's remark that "the remaining Regulations are printed almost in full" is hardly correct, and is refuted by the fact that the remaining 35 pages of the I.E.E. Regulations have been reduced to 16½ pages, being more than a 50 per cent. decrease.

"H.R.T.'s" statement that "the diagram under (41) does not agree exactly with the text of the Regulation" is not correct. We certainly cannot agree that there is any disagreement between diagram (41) and the Regulation of that number.

It is regretted that the term "Fuseboard" has been used in Diagram 42A(a). It is obviously an error, but this hardly warrants the assertion that it has been used "indiscriminately."

We welcome constructive criticism, and are deeply grateful to "H.R.T." for the careful criticism he has given "The Employees' Guide." We can assure him that any of the improvements or alterations he has suggested which can be made use of will be embodied in the next edition.

If the letters of appreciation and repeat orders we have received may be taken as an indication, "The Employees' Guide" will serve a useful purpose.

A. Brammer,
General Secretary, ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS.

London, *August 15th*, 1927.

The I.E.E. Council "Ballot."

Some years ago, it will be recalled, the method of electing the Council of the I.E.E. was re-organised. While the working of the revised system has turned out to be excellent, as the choice of new members of Council has so far proved very wise, there is a danger in that, for all practical purposes, the whole of the elections lie in the hands of the members of Council. In this democratic age, the other members should have a chance of voting—even if they do not exercise it. True, after the Council has notified the members as to its choice, an opportunity is given for alternative proposals, but no wise man would allow his name to be put forward under such circumstances, as it is virtually a reflection upon the

choice of the Council; hence in practice it is impossible to get any good men to stand who do not happen to be selected by the Council. This weakness in the present method could easily be remedied by (*a*) the suggestion on the part of the Council of two names for each vacancy, and (*b*) a request for names to be submitted for its consideration *before* it announces its choice. The last "ballot" was rather a farce, as there was no possibility of voting, since no alternative names were offered. As there were forty-six spoiled ballot papers, evidently some members deleted names of which they did not approve, which is at least a hint to the Council that it is not quite infallible.

Wood B. Vota.

London, *August 9th*, 1927.

[Method (*a*) was virtually in force for some years, but was open to an objection similar to that pointed out by our correspondent. Method (*b*), in effect, is always available, for members can submit names in advance of the Council's selection. The real defect in the system is the disclosure of the Council's choice, which, as our correspondent indicates, tends to prejudice the chances of election of an outside nominee. If all the names put forward were on an equal footing—*i.e.*, if no indication were given as to which were the Council's nominees and which were not—the elections would be perfectly fair and free from the reproach which is constantly cropping up.—Eds. Elec. Rev.]

The Profits of Electricity Supply Undertakings.

Mr. H. M. Sayers somewhat enlarges upon the above article. One of the objects of the article was to subject to criticism the opinions held by certain town councillors, officials, and the staffs of technical journals that the establishment of a reserve fund at or approximating to its maximum figure necessarily indicates a very healthy financial condition in the case of an electricity supply undertaking. It certainly was not intended to convey the impression that a reserve fund of 10 per cent. of the aggregate capital expenditure is a statutory minimum, though unfortunately in many instances those responsible for the financial administration of supply undertakings seem to regard the reserve fund from that point of view. It should always be borne in mind that the effect of the creation of a reserve fund has been to raise by the amount in the fund the price charged for electricity over a period to consumers.

Regarding Mr. Sayers's remarks in the last paragraph of his letter, variations of Section 7 of the Clauses Act, 1899, as to the methods in which the reserve fund can be applied, have from time to time been incorporated in private Acts. Section 110 of the Bolton Corporation Act, 1922, states that the provisions of Section 52 (Application of Revenue) of the order of 1891 with respect to the reserve fund shall be read as if the words "One fifth" were inserted instead of "One tenth," and the fund shall be applicable for the purpose of *extending* and *improving* buildings, plant, and apparatus forming part of the electricity undertaking.

The Tunbridge Wells Electric Lighting Extension Order, 1915, contains a clause which states that the undertakers may, if they think fit, instead of carrying the annual proceeds of the reserve fund when amounting to the prescribed limit to the credit of the local rate, apply the whole or any portion thereof to the purchase of electric mains, machinery, &c., and to the formation of a fund for working capital; provided that the fund so formed shall not at any time exceed a sum equivalent to *one half* of the gross annual revenue of the undertaking for the time being.

Further, the London County Council (General Powers Bill, Section 56) is a departure from the Clauses Act of 1899, in that it enables London boroughs owning electricity undertakings to allocate any net surplus to finance outlays on the extension of the undertaking, instead of raising special loans for the purpose.

I am not aware of any Local Act which prescribes a reserve fund of some *minimum* percentage.

Accountant.

August 12th, 1927.

Rural Electric Lines.

As I read Mr. W. Fennell's contribution to this subject on p. 246 of the Electrical Review of August 5th, 1927, it occurred to me that what was required was an "Overhead Lines Club" along the lines of the popular "Point-fives" of pre-war days. Qualification for associate membership—the erection of over five miles of overhead line; qualification for membership—the erection of over fifty miles. Subscription—nil. Conditions of joining—that a letter be written to the Editor of the Electrical Review, simply stating qualification for either class. At the present moment it is not easy to get together a list of electrical engineers who have had overhead line experience, hence a collection of such names would be very useful to the Institution of Electrical Engineers, the Electricity Commissioners, and other similar bodies. There is at present an opportunity to suggest revisions for existing overhead lines regulations. As Mr. Fennell indicates, the men who have had experience ought to be in a position to greatly assist the electrical industry as a whole, by giving of their experience. From this experience, decisions can be made as to the extent to which regulations can be eliminated. Regulations are not really needed for competent engineers; they are only required to compensate for the lack of knowledge on the part of others. Unfortunately, in providing regulations for the latter class, the former are handicapped. A very satisfactory new regulation would be to the effect that "These regulations shall not apply to overhead lines designed and/or erected by competent electrical engineers, who have satisfied the Electricity Commissioners as to their qualifications: provided that copies of all standard or special drawings employed for any work be signed and certified by the competent engineer as complying with his experience of sound and reasonable design and filed at the offices of the electricity supply undertaking for which the work is being carried out."

I would explain to Mr. Fennell that my comments were intended to indicate that as much experience was necessary to erect overhead lines as to lay cables, or any other similar branch of engineering. A man erecting his first line must be looked upon as an amateur. Many uninitiated persons seem to think that there is nothing much in the art of overhead line construction.

To support my own suggestion, I should be glad if you would record my name as a member of the "Overhead Lines Club."

R. Borlase Matthews,

Wh.Ex., A.M.I.C.E., M.I.E.E., F.R.Ae.S.

East Grinstead, *August 8th*, 1927.

The Electric Railways of Great Britain.

Annual Returns of the Ministry of Transport.

LAST week the annual returns of British railways for the year 1926 were published by the Ministry of Transport (H.M. Stationery Office, price 21s. net). Particulars relating to electric railways are brought out separately in appendices, from which we learn that the length of road solely worked by electric traction at the end of 1926 was 126 miles (in 1925, 121¼), and partly worked by electric traction 401½ miles (344½), the total being therefore 527½ miles electrically equipped; the corresponding length of single track, including sidings, was 1,393 miles (1,215 in 1925). (The total length of road open for traffic on all systems was 20,396 miles, or, expressed as single track, 37,058 miles). The Southern Railway operated 228 miles of road, of which 40 miles was equipped on the overhead system and the rest third-rail. The L.M. & S. Railway owned 101 miles, of which 41 was in the London area and 60 in Lancashire (mainly in the Liverpool and Manchester districts). The L. & N.E. Railway owned 57 miles, mostly in the north-eastern area, and the Great Western Railway 5¼ miles. Apart from the sections belonging to the above-named companies, the electric railways in the Metropolitan area comprised 125 miles of road, and the remainder, 11¼ miles, was almost equally shared by the Liverpool Overhead and the Mersey Railways. The aggregate length of the electric railways in the Metropolitan area was 405¼ miles; in the Lancashire area 72; and in the N.E. area 50 miles.

The electricity used during the year on the d.c. system for traction purposes, including the heating and lighting of trains, amounted to 457.86 million kWh (443.5 in 1925), measured as low-pressure energy, corresponding to 52.89 kWh per electric locomotive (passenger), 31.91 (freight), and 88.44 (motor vehicle), per 1,000 gross ton-miles. The mileage of electric locomotives was 698,338 miles, and that of motor vehicles was 80.98 million miles, d.c.

The a.c. systems (Southern, 45 miles, Heysham-Morecambe-Lancaster, 9¼ miles of road) were supplied with 34.12 million kWh, measured as high-pressure energy (33.17 in 1925), or 77.38 kWh per 1,000 gross ton-miles (76.14); the mileage aggregating 3,562,030 motor vehicle miles, of which all but 97,000 miles was run on the Southern Railway system. The aggregate electric mileage run was 40.21 million passenger train-miles and 197.29 million vehicle miles (38.23 and 188.5 millions in 1925); freight trains covered 39,109 train miles and 1.83 million vehicle miles, mainly in the north-eastern area (76,905 and 4.13 millions in 1925, the difference being obviously due to the coal dispute). The number of electric coaching vehicles in use was 4,497, an increase of 262. The electrically-operated mileage showed an increase of 4.99 per cent. over 1925.

The capital invested in electric power stations, &c., was £7,299,748, showing little increase since 1923. The maintenance of electric track equipment cost £154,964. Electric train working cost for wages of motormen, £460,535; electrical energy, £1,955,047; lubricants, £19,925; and other stores, £40,723. Generating costs at railway power stations amounted to £1,001,001, and distribution costs to £149,947, the total expenditure, including depreciation, being £1,424,668, which was allocated as follows: Traction, 214.5 million kWh, £898,406; power, 29.5 millions, £184,505; lighting, 26.1 millions, £245,346; other consumers, 14.5 millions, £96,351.

The number of electric locomotives in traffic use was 42; electric motor-cars, 1,949; carriages worked by electric power, 2,548

Legal.

Alleged Theft of Electrical Goods.

THE *Yorkshire Post* reports that at Middlesbrough, on August 10th, William Scarth, formerly employed by the British Thomson-Houston Co., Ltd., was charged with the theft of electrical goods valued at £260. Charges were also preferred against Andrew Matson and Cecil Ridley (an electrical factor) of receiving the goods. In addition, there was a charge against all three of conspiring to steal radio valves, cable, lamps, and an accumulator charger from the British Thomson-Houston Co., Ltd.

For the prosecution it was stated that the company found, when stocktaking, that over 2,000 lamps, four cases of radio valves, and other goods were missing. It was then discovered that Ridley was selling "B.T.-H." valves at less than the proper price, and two valves purchased from him were found to bear numbers belonging to missing valves. Subsequently Ridley made a statement which led to the apprehension of Matson. The latter alleged that he told Ridley that the valves had been stolen. Scarth alleged that he was induced by Matson to steal goods from the company's store, and he was paid not more than £20 for them. To get away from Matson's influence he joined the Army. For Ridley it was urged that he did not know that the goods were stolen; other reputable firms in the town had purchased alleged stolen goods from Matson. Scarth pleaded "Guilty" and the other defendants "Not guilty." The Stipendiary Magistrate decided that there was a *primâ facie* case, and committed all three defendants for trial at the next Assizes, bail being allowed.

False Pretences Charge.

AT Old Street Police Court, on August 8th, Forrest Trevor Williams, wireless dealer, Sutton, Surrey, was charged on remand with unlawfully and knowingly obtaining by certain false pretences, on April 13th, from Rène Rich, a quantity of wireless accessories, value £52 9s. 6d., the property of Abraham Rich, wireless accessories factor, of Norton Folgate, E. Mr. Frank Powell, prosecuting, stated that there were now further charges against the prisoner, *viz.*, that on April 22nd and 23rd he unlawfully and knowingly obtained by false pretences a quantity of radio accessories, value £48, the property of the General Electric Co., Ltd., with intent to defraud; and on April 22nd he unlawfully and knowingly obtained by false pretences a quantity of radio accessories, value £21 5s. 7d., the property of S.T., Ltd.

Mr. J. G. C. YALE, who appeared for Williams, said that his client would reserve his defence as regarded the first charge.

Mr. CLARKE HALL said that if the case were going for trial to the Sessions he would remand it to some date when there was more time for it to be heard. The case was remanded till August 19th, the prisoner being admitted to bail.

Caerphilly Urban District Council v. "Merthyr Express."

IN the Vacation Court, on August 10th, Mr. Justice Clauson had before him a motion by the Caerphilly U.D.C. to commit the Editor of the *Merthyr Express* for alleged contempt of court in commenting upon a pending action by the Council against a Mr. Griffin, who, it was stated, was proposing to supply electricity in contravention of the provisions of the Electric Lighting Act, 1909.

Mr. BELSHAM, for the Council, said it had a special Order under which it undertook to supply electricity to a specified area. Mr. Griffin was a local tradesman and the owner of a parcel of land adjoining his shop, upon which he had recently erected a number of buildings, the tenants of which he was proposing to supply with electricity generated by himself. The only point at issue in the action against Mr. Griffin was whether this came within a proviso in the Act. After the action had been set down for trial an article appeared in the *Merthyr Express*, the greater part of which was a puff of Mr. Griffin's business activities, but the rest was a gross misrepresentation of the issues involved in the action, and calculated to prejudice the Council in the eyes of the public and throw upon it the odium of making overcharges.

Mr. PRESTON, K.C., for the Editor, while denying that there had been any contempt, said the article was written by a local correspondent who did not know that proceedings had been taken. If there had been contempt, his client expressed regret.

His LORDSHIP said these mistakes would occur, and he was sure that the Editor had no desire to do anything wrong. Through a slip, there had been an error. A good purpose had been served by bringing the motion on and giving publicity to the matter, and he thought it might well be left there. There would be no order on the motion, and each side would pay its own costs.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1925.

18,521. "Electrically-operated signals for vehicles." W. M. Rolph. April 20th, 1926. (274,158.)

1926.

4,945. "Acoustic amplifiers and radiators suitable for use with loud-speaking telephonic receivers and other sound-producing or reproducing apparatus." M. Graham and A. Graham (legal representatives of E. A. Graham (deceased)). February 20th, 1926. (Addition to 257,639.) (274,532.)

7,557. "Electric controlling apparatus for supplying current to electric nets." A. J. Stephens (J. Soloman). March 18th, 1926. (274,536.)

10,240. "Röntgen apparatus." Electricitäts Ges Sanitas. April 18th, 1926. (250,977.)

10,389. "Ventilation or pressure relief of fireproof electrical apparatus." Diamond Coal Cutter Co., Ltd., and J. Lithgoe. April 20th, 1926. (274,553.)

10,405. "Telephone systems." Standard Telephones & Cables, Ltd., and G. C. Hartley. April 20th, 1926. (274,555.)

10,566. "Electric switches." G. Wall and Metropolitan-Vickers Electrical Co., Ltd. April 21st, 1926. (Addition to 253,242.) (274,559.)

10,567. "Electrical resistances." S. C. Lloyd, P. L. Harlow and Metropolitan-Vickers Electrical Co., Ltd. April 21st, 1926. (274,560.)

10,568. "Telephone systems." Standard Telephones & Cables, Ltd., L. P. Lowry, J. R. Gould, and A. H. Cameron. April 21st, 1926. (274,561.)

10,731. "Underframes and bodies for tramcars." Brush Electrical Engineering Co., Ltd., and W. E. Hall. April 23rd, 1926. (274,569.)

10,837. "Electrical measuring instruments such as voltmeters, amperemeters, and wattmeters." W. J. Rickets. April 24th, 1926. (274,575.)

10,840. "Sound-amplifying devices for use with telephone receivers." F. J. Empson. April 24th, 1926. (274,576.)

13,081. "Electric cooking and heating apparatus." G. A. Hughes. May 21st, 1926. (274,606.)

14,548. "Electric fire or radiator." H. H. Berry. June 9th, 1926. (274,615.)

15,155. "Electrical control apparatus." C. Ryder and Metropolitan-Vickers Electrical Co., Ltd. June 16th, 1926. (274,620.)

15,958. "Valve gear and magneto driving gear for internal-combustion engines." J. Bamford and C. J. Bamford. June 25th, 1926. (274,626.)

17,022. "Lids of accumulator boxes or cases." W. Haddon and J. M. Burnett. July 7th, 1926. (274,632.)

20,360. "Stabilisation of high-frequency oscillations." C. W. Goyder. August 18th, 1926. (274,660.)

22,663. "Electroplating." H. Göthe. September 14th, 1926. (274,671.)

23,315. "End grips for cables." Callender's Cable & Construction Co., Ltd., and W. H. Isherwood. September 21st, 1926. (274,675.)

27,320. "Variable directional electric wave-generating device." H. Yagi. December 29th, 1925. (263,752.)

27,925. "Speed-control systems." British Thomson-Houston Co., Ltd. November 6th, 1925. (261,031.)

28,272. "Sound amplifiers." G. E. Soero. November 10th, 1926. (274,689.)

28,793. "Electrical indicating, recording, and regulating apparatus." W. H. Apthorpe and Cambridge Instrument Co., Ltd. November 15th, 1926. (274,692.)

29,966. "Three-phase transformers." Siemens-Schuckertwerke Ges. and Dr. K. Kurda. November 26th, 1926. (274,701.)

30,176. "Amplifying apparatus for crystal receiving sets in wireless telephony and telegraphy." C. A. Renaud. December 24th, 1925. (263,769.)

30,623. "Electricity meters of the induction type." Korting & Mathiesen Akt. Ges. and R. Kopp. December 3rd, 1926. (274,704.)

31,719. "High tension electric apparatus working in oil." International General Electric Co. Inc. December 17th, 1925. (263,151.)

32,118. "Sound amplifiers." Columbia Graphophone Co., Ltd. May 28th, 1926. (271,813.)

32,211. "Apparatus for use with telephone mouthpieces." L. J. Gamoty. December 20th, 1926. (274,714.)

1927.

306. "Advertising gramophone driven by an electric motor and acting automatically." Naamlooze Vennootschap Reclamophoon-Maatschappij and J. Drukker. January 5th, 1927. (274,723.)

420. "Protective arrangements for electric apparatus." British Thomson-Houston Co., Ltd. January 6th, 1926. (264,168.)

1,747. "Instrument for electric ionic medication." W. Richter. March 24th, 1926. (268,294.)

2,517. "Process and apparatus for providing carbon electrodes with metal crowns." T. Pogany and E. Bagota. January 28th, 1927. (274,735.)

2,666. "Portable apparatus for use in the treatment of patients with electric light." St. Dunstan's and N. Warren. January 29th, 1927. (274,739.)

4,603. "Systems for protecting electric transformers." British Thomson-Houston Co., Ltd., H. S. Holbrook and C. G. Mayo. February 18th, 1927. (Addition to 176,134.) (274,749.)

5,011. "Automatic reclosing circuit-breaker systems." British Thomson-Houston Co., Ltd. February 23rd, 1926. (266,717.)

9,754. "Electric switches." A. K. Croad (Eastern Laboratories Inc.). April 19th, 1926. (Divided application on 10,277/26.) (274,770.)

9,967. "Electrical flashlight apparatus." Svenska Aktiebolaget Gas Accumulator. May 20th, 1926. (271,424.)

10,602. "Small commutator motor." Landis & Gyr Soc. Anon. May 3rd, 1926. (270,282.)

11,870. "High ohmic resistances variable by steps." S. Loewe. May 3rd, 1926. (270,355.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from August 10th:—

E.E. (lettering and design). No. 477,666. All goods in Class 6.—English Electric Co., Ltd.

Microfu. No. 480,801. Class 8. Instruments and apparatus for use in radio-telegraphy or telephony.—Microfuses, Ltd., 3, Finsbury Square, E.C.2.

Vegofort. No. 480,940. Class 8. Apparatus for use in radio-telegraphy and telephony.—T. O. Peet, 35, London Road, Portsmouth.

Oravox. No. 481,533. Class 8. Telephonic instruments and apparatus.—Pedestros, Ltd., 28, Langham Street, Portland Place, W.1.

Dewola. No. 482,038. Class 8. Radio receiving sets.—Alfred J. Dew, trading as A. J. Dew & Co., 33-34, Rathbone Place, W.1.

Blitz. No. 479,267. Class 13. Electric switches of ordinary metal for use in connection with household lighting.—Fresen & Co., Ludenscheid, Germany. (British representatives: H. Gardner & Son, 173-175, Fleet Street, E.C.4.)

Electrolux. No. 478,771. All goods in Class 18.—Electrolux, Ltd.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ARNOLD (Notts.).—School (500 places); director of education, County Education Offices, Nottingham.

BECKENHAM.—Secondary school; Kent Education Committee.

BENTLEY (Yorks.).—Saw mill, Bentley Road, for Jenkinson and Sons.

BEXLEY.—Cinema. Park View Road, Welling, for the Rialto Cinemas (Welling), Ltd. Central school; Kent Education Committee.

BIRKENHEAD.—Electric lighting, Queen's Buildings, borough engineer.

BIRMINGHAM.—Roman Catholic church; Rev. F. H. Drinkwater, rector of Holy Family Church, Small Heath.

BLACKBURN.—Extension of Stancliffe Street Mill, for Witton Mill Co.

BRENTWOOD.—Rebuilding premises, High Street, for the London Co-operative Society; secretary.

BROOKWOOD.—Reception hospital, Mental Institution; Surrey C.C.

BRUMBY.—School (£18,850), for Lindsey E.C.; director of education, Lincoln. Isolation hospital (£24,150), for Lindsey C.C.; clerk, The Castle, Lincoln.

CHERTSEY.—Some hundreds of houses, near Sorbo Works; Architectural Town Planning Association, Ltd.

COLCHESTER.—Arcade of shops, Long Wyre Street to Queen Street, for F. E. Locke. Central school and Council school at Lexden; director of education.

COVENTRY.—Extensions, motor-'bus garage (£7,800), for the T.C.; borough engineer.

DAGENHAM (Essex).—Cinema, Goresbrook Road, for J. Kaye.

DAILLY (Ayrshire).—Masonic temple, for the Ferguson St. James Lodge; secretary.

DARTFORD.—Cement stores, Dartford wharf; Darby Bros.

DEWSBURY.—Children's ward, District Infirmary; governors.

DONCASTER.—Extensions to the Technical and Art Schools (£12,000); Education Department.

DORCHESTER.—Electric lighting, waterworks pumping station; borough engineer.

DUDLEY.—Locomotive shed, Cinder Bank; O. Grazebrook.

EDINBURGH.—Hall for City Mission; the superintendent.

EGREMONT (Cumberland).—Electric light installation, Parish Church; Rev. Irvine Earnshaw, rector.

ESTON.—75 houses; U.D.C. surveyor.

FAIRHAVEN (near Blackpool).—Girls' secondary school (£50,000), for trustees, Lytham Schools' Foundation.

FARNHAM.—Adaptation of premises for municipal offices; A. J. Stedman, for U.D.C. Additions, Wrecclesham Potteries; A. Harris. Additions, Farnham Gas and Electricity Co. offices.

FISHERTON.—Extensions, public schools, for Ayrshire E.C.; William Reid, master of works, Education Offices, Ayr.

GLAMORGAN.—New admission block at the Angleton Mental Hospital; County Council.

GLASGOW.—College, dairy school, &c., Pollok (£150,000), for the governors of the West of Scotland Agricultural College. 318 houses for Corporation; City Housing Department. 38 houses for Taylor & Wilson, Halfway, Paisley Road; the manager. Diversion of railway lines and construction of mineral depôt at Knightswood; M'Kean & Renwick.

GLOSSOP.—Boiler house, Turn Lee Mills; Olive & Partington.

HAYWARDS HEATH.—Extensions, King Edward VII Memorial Eliot Hospital; R. M. F. Huddart, architect, 4, Grosvenor Hill, Wimbledon.

HERNE BAY.—Block of offices and seven flats, &c., High Street; C. H. H. Kenworthy.

HULL.—Increased storage accommodation at docks; Corporation and L.N.E.R. Electric lighting, St. Paul Street Baths; city engineer.

ILKESTON.—Commercial garage, Chapel Street; A. B. Inglis.

KILMARNOCK.—Extensions to technical school, with electrical work, for Ayrshire E.C.; William Reid, master of works, Education Offices, Ayr.

KIRKCALDY.—Extensions, district isolation hospital, with electrical and heating work; D. Forbes Smith & Johnston, architects, 244, High Street.

LICHFIELD.—High school for girls; G. C. Lowbridge, architect.

LONDON (Barking Town, E.).—30 flats, Gascoigne Road; U.D.C. surveyor. Electrical installation, St. Joseph's Schools, Howard Road; Rev. Father Van Meenan.
(Blackfriars, S.E.).—Cold store on the Thames for the New Zealand Meat Producers' Board.

MERTHYR TYDFIL.—Mining institute, for the Borough E.C.; borough engineer.

MORETON (Birkenhead).—Church, Dureen Road, for the Baptist trustees; secretary, Victory Hall.

NEWCASTLE.—92 houses at Walker and 161 at Pendower; H. Kindred. 850 houses, new estate at Lonnen; city engineer. Municipal office extensions (£41,750); city engineer.

ORPINGTON.—Secondary school; Kent Education Committee.

PETERBOROUGH.—Rebuilding premises, King Street, for Thomson's, Ltd., drapers (one of the Selfridge Stores, London).

PLYMOUTH.—Laboratories and workshops, Junior Technical School, Durnford Street; Education Committee.

POCKLINGTON (Yorks.).—Cinema, for Allison & Sons.

PONTYPOOL.—Roman Catholic church, Grahamstown; Rev. F. C. Lynch, rector.

PORTSLADE-ON-SEA.—Memorial hall, with welfare institute and dining and concert halls, for Ronuk, Ltd.; Gilbert M. Simpson, architect.

RICHMOND.—Extension for new clinic, Royal Hospital; governors.

ROMFORD.—Electric light installation, Parish Church; the vicar.

ROTHERHAM.—Six shops and offices, Corporation Street; George Saul & Sons, Ltd.

RUNCORN.—Business stores, High Street, for the Runcorn and Widnes Co-operative Society; secretary.

SITTINGBOURNE (Murston).—Premises, electrically equipped, for Smeed, Dean & Co., Ltd., brick manufacturers.

SOUTHEND-ON-SEA.—Hospital; H. Percy Adams, architect, 9, Knightsbridge, London, S.W.

STALYBRIDGE.—Electric lighting installation, Lancashire Ward No. 2, Conservative Club, Stamford Street; J. J. France, secretary.

STIRLING.—Electric lighting installation, Institution, for the Combination Poorhouse Board; Mr. Inglis, electrical engineer, Glasgow.

STOURPORT.—Showrooms, Severn Valley Carpet Works, for T. Bond Worth & Son.

TUNBRIDGE WELLS.—Additional 50 houses, for the T.C.; borough surveyor.

UPPER HOLKER.—School, Brow Edge (£11,060), for Lancs. E.C.; Director of Education, Preston.

WAKEFIELD.—Workshops, Stennard Isle; British Spiro Turbine Co., Ltd. Additions, workshops, Belle Isle; West Riding Electric Tramway Co., Ltd. Maternity home; governors, Clayton Hospital.

WATFORD.—Church and schools, Harebreaks estate, for Wesleyan trustees. Stores, &c., Whippendell Road; Sun Engraving Co.

WEDNESBURY.—Extensions, county technical college, including metallurgical laboratories, &c., for Staffs. E.C.; F. A. Hughes, director of education, Stafford.

WINCHESTER.—Extensions, central premises, for the Co-operative Society; Geoffrey Denham, architect, 41, Jewry Street.

WOLVERHAMPTON.—Additional 200 houses, Low Hill estate, and isolation block, borough hospital (£3,058), for the T.C.; borough surveyor.

WORKSOP.—Technical and mining college; Director of Education, County Education Offices, Nottingham.